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Your Time Is Now
OpenDaylight: The Open Source SDN Controller Platform

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PSOSDN-2761
Agenda

• What is SDN and OpenDaylight?
• OpenDaylight Architecture
• Use Cases
• Resources
What is SDN?

- Control & Data Planes separation?
  - OpenFlow?
  - Logically centralized control Plane?
  - White label switches?

- This a valid & useful SDN use case, but...

- SDN can be defined more broadly:
  - Network is a source of vast amount of other useful data...
  - ..that can be utilized by variety of SDN applications
SDN and Orchestration: End-to-End Modeling

- Application Developer Environment
- Management and Orchestration
- Analysis and Monitoring, Performance and Security
- Network Services
- Control Plane
- Forwarding Plane
- Network Elements and Abstraction
- Transport
- SDN

Products
Service Models
Device Models

Harvest Network Intelligence

Program for Optimized Experience

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What Should an SDN Controller Look Like?

• A *platform* for deploying SDN applications

• Provide an *SDN application development environment*. 
SDN Controller: Platform Requirements

• Flexibility:
  • Accommodate a variety of diverse applications
  • Controller applications SHOULD use a common framework and programming model, and provide consistent APIs to their client

• Scale the development process:
  • No infrastructure code hotspots
  • Independent development of controller applications & short integration times

• Run-time Extensibility & Modularity:
  • Load new protocol and service/application plugins at run-time.
  • Adapt to data schemas (models) discovered in the network

• Performance & Scale
SDN Controller: App Development Requirements

- A domain-specific modeling language to describe internal and external system behavior
- Modeling tools for the controller aligned with modeling tools for devices
- Code generation from models:
  - Enforce standard API contracts
  - Generate boilerplate code performing repetitive and error-prone tasks
  - Produce functionally equivalent APIs for different language bindings
  - Model-to-model adaptation for services and devices
  - Consumption of other service models

In the OpenDaylight Project, these requirements are satisfied with YANG (and YANG extensions) and via our YANG tool-chain, manifested in the MD-SAL
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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| 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. |
In a Nutshell, OpenDaylight…

... has had 31.388 commits made by 696 contributors representing 2,614,066 lines of code

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

... has a well established, mature codebase maintained by a very large development team with stable Y-O-Y commits

... took an estimated 764 years of effort (COCOMO model)
OpenDaylight

- The biggest networking OSS project by any measure (www.openhub.net):

  - 150+ known* deployments by 20+ companies
    - SW / Equipment vendors, SPs, …
    - Networking, entertainment, energy management, …

* = reported to Linux Foundation
OpenDaylight Architecture
For years we thought SDN was all about this piece of the puzzle and then realized the protocols were limiting innovation.
OpenDaylight: From Layers to Microservices
Software Architecture

- OSS/BSS, External Apps
- Network Devices
- Protocol Plugin
- Netconf Client
- RESTCONF Application
- REST Application
- Netconf Server
- Data Store
- Model-Driven SAL (MD-SAL)
- Yang Model
- RPCs
- Notifications
- Data Change Notifications

Apps/Services
“Kernel”
Data Store Sharding

- **Select data subtrees**
  - Currently, can only pick a subtree directly under the root
  - Working on subtrees at arbitrary levels
- **Map subtrees onto shards**
- **Map shards onto nodes**

Shard Hash Function:
Divide the tree into n shards

ShardX.Y:
X: Service X
Y: Shard y within Service x

Shard Layout Algorithm:
Place shards on M nodes
Example Processing Pipeline: BGP

BGP PDU In  BGP PDU Out

BGP Peer  RibIn Policy  LocRib Writer

AdjRibIn  Effective RibIn  LocRib  AdjRibOut

SAL/Core
Controller

---→ Data Change Notification
→ Data Store Write
→ RPCs/Notifications

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Example Processing Pipeline: OpenFlow
Streamlining the App Development Process

Informal Models (UML, SID, ...)

Product Owners

Programmers

Bag of developed integrated software components

EMS

Information Models

Product Owners

Formal Data Models

Programmers

YANG

Auto-generated code from models; APIs rendered at run-time

SDN App
Simplified Network Application Life Cycle

End-to-End Model-Driven Architecture

Application change

Auto-update API

Autogenerate code

Load NE Model

Feature change

Controller

Network Representation

Network Element

Network

Application

Application

Application

API

API

API

API

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Use Cases
Key Components

- GBP Neutron Mapper:
  - Translate Neutron calls to generic GBP
- VPP Renderer:
  - Manage attachments (VMs, taps, etc.)
- Overlay Topology Mgr
  - Manage overlay tunnels: VXLAN, NSH, SR, ...
- L2 Forwarding Mgr (VBD):
  - Manage forwarding over tunnels (incl. end-point reachability) for L2
- L3 Forwarding Mgr
  - Manage underlay and overlay L3 forwarding
- Route Server:
  - routing for underlay
  - routing for overlay MPLS/VPN
  - peering with external networks
- Honeycomb:
  - VPP config and oper data (via NC/Y)
  - propagate routing information (IGP, BGP) to XRv
  - propagate interface up/down to VBD and XRv
Satellite Network
Data Collection / Analytics with PaNDA

Data Platform

High performance pub/sub bus

Data Distribution

Data Store & Processing

Real Time Query

Deep Historical Query

Batch Processing

Master Data Store

Real Time Data Store

Publisher: Data aggregation

Collectors:

SNMP, CLI

ODL Kafka plugin

Data sources

CMTS/VCM TS

STB

Modem

CMTS/VCM TS

SNMP, CLI

Data sources

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Data sources

CMTS/VCM TS

STB

Modem

CMTS/VCM TS

SNMP, CLI

ODL Kafka plugin

Log Search

Billing (Mediation)

Business Intelligence

Capacity Analytics

Fault Analysis

Perf Analysis

Security and Threat Analysis

Inventory

Real Time

Data Store

Deep Historical Query

Batch Processing

Master Data Store

Real Time Data Store

Publisher:

Data aggregation

Collector:

ODL

K

SNMP

Monit, Collectd, Logstash, Ceilometer

SNMP

Metric aggregation

Log Aggregation

Network Telemetry

Event aggregation
Iot Controller & Data Collector

IoT Dashboard

IoT Data Collector

Select Data

IoT/SDN Controller

Device Management Console

Policy Push (Krikkit)

IoTDMDoneM2M

OPEN DAYLIGHT

ONE M2M

OPEN DAYLIGHT

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Resources
Resources

• More information and to join:
  • http://wiki.opendaylight.org

• Keep informed and join the conversation
  • IRC: #opendaylight on Freenone

• Open mailing lists:
  • lists.opendaylight.org

• @openDaylightSDN

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Thank you