Accelerate SDN Adoption with Open Source SDN Control Plane

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Thinking influenced by Nick McKeown, Scott Shenker, and Colleagues at ON.Lab, Stanford

I am responsible for any faults
Network operators love SDN
They want to adopt it
Still they are too slow to deploy it
Why?
Why Network Operators Slow to Deploy SDN?

SDN needs to mature

Network operators increasingly dependent on leading incumbent vendors
Critical SDN Components

- (Commodity) OF/SDN optimized forwarding devices (switches)
  - Expect silicon and (white box) vendors to step up to deliver
  Not focus of this talk

- Distributed SDN Control Plane
  - Scale-out, HA, north bound API, performance

- Compelling use cases

Open Source ONOS Project with a difference
Every disruptive technology takes time to mature

But SDN has its own challenges due to how the network industry works
Network Operators and Vendors

Vendors

Leading Incumbents

Highly profitable
Own the market

Out sourced too much to vendors

Design, build, & operate customer networks

Network Operators

Depend on Vendors

Profitability under pressure

Leading incumbents not likely to deliver “real SDN” any time soon
Surprised?
Incumbents’ Approach to SDN

- Phase 1
  - Incumbents ignored SDN

- Phase 2
  - Incumbents actively played SDN down and in denial

- Phase 3
  - Incumbents “embrace” SDN; claim to be SDN leaders
  - Incumbents redefine SDN to preserve their legacy
Incumbents’ Approach to Preserving Legacy

Start with Closed Proprietary Vertically Integrated Complexes

Claimed Advantages?
- Allows the customer to realize benefits of SDN on the same infrastructure
- Allows the vendor to build SDN on its existing products

So what is wrong?
What is Wrong with Incumbents Approach?

- Everything!
- It compromises all SDN principles and benefits
  - Keeps distributed control plane embedded into proprietary boxes
  - Adds another control plane: more cost & complexity
  - Does not help with capex, opex, and new services except simple provisioning/orchestration
Network Operators’ Challenge

How can Network Operators realize SDN value?
How to help network operators realize SDN?

Technology Building Blocks

- Commodity OF/SDN optimized forwarding devices (switches)
- Distributed SDN Control Plane
- Compelling use cases

Open Source ONOS Project

With Network Operators and Vendors*

Vendors*: Ones that are willing to challenge the status quo

To break network operators dependence on a few vendors and create more choices for operators
Network Operators
Carriers/Enterprises

Vendors*

Team with Expertise in SDN, Distributed Sys, Use cases, Open Source

SDN Researchers Innovators

Open Source ONOS Project with a difference

Open Source SDN Control Plane Features, Functions, Performance

Compelling Use Cases

Demonstrations

Trial Deployments
Open Source ONOS Project

Team with Expertise in SDN, Distributed Sys, Use cases, Open Source

- Use cases
- Network knowledge

Network Operators
Carriers/Enterprises

Vendors*

Expertise
Network Sys, Dev

Researchers
Innovators

Open Source
SDN Control Plane
Features, Functions, Performance

Compelling Use Cases
Demonstrations
Trial Deployments
ONOS: An Open Source Distributed Network OS

ON.Lab Team
Open Network OS (ONOS): Focus
(Started in Summer 2012)

Global Network View

ONOS

Packet Forwarding

Packet Forwarding

Packet Forwarding

Programmable Base Station

Routing

TE

Mobility

Global network view

Scale-out Design

Fault Tolerance

Open Network OS (ONOS): Focus
(Started in Summer 2012)
ONOS High Level Architecture

Network Graph
Eventually consistent

Titan Graph DB

Cassandra In-Memory DHT

Distributed Registry
Strongly Consistent

Zookeeper

Instance 1
OpenFlow Controller+

Instance 2
OpenFlow Controller+

Instance 3
OpenFlow Controller+

Distributed Network Graph/State

Coordination

Scale-out

+ Floodlight Drivers
Prior Work

ONIX
- Distributed control platform for large-scale networks
- ONOS design influenced by ONIX
- ONIX: closed source; datacenter + virtualization focus

Other Work
- Helios (NEC), Midonet (Midokura), Hyperflow, Maestro, Kandoo, …
- NOX, POX, Beacon, Floodlight, Trema controllers

Community needs an open source distributed SDN OS
Network Graph: Switches
Network Graph: Link Discovery

Link Discovery
SM  LLDP

Link Discovery
SM  LLDP

Link Discovery
SM
Network Graph: End Devices
Path Computation with Network Graph
Network Graph and Flow Manager
Demo: ONOS for Service Provider WAN
ONS, April 2013
Lessons Learned

• Scale-out design with HA is important
• Network graph is a promising north-bound abstraction
• Achieving performance with off-the-shelf open source components difficult
• There are many systems challenges
  – Distributed data store and state synchronization
  – Choice of consistency models for different network state
  – CAP theorem implications
  – Efficient and low latency events/notifications functionality
  – Performance: targets and how to achieve them
ONOS Work In Progress

**ONOS Core**
- Low-latency distributed data store
- Events, callbacks and publish/subscribe API
- Expand graph abstraction for more types of network state

**ONOS Apps**
- Control functions: intra-domain & inter-domain routing
- Example use cases: traffic engineering, dynamic virtual networks on demand, ...

**Community**
- Work with key partners: service providers, a few vendors
- Support deployments in R&E networks and trial deployments with network operators
Being deployed in R&E Networks

Learn more at http://onlab.us/tools.html

ONOS Next Phase
Team with Expertise in SDN, Distributed Sys, Use cases, Open Source

Open Source ONOS Project
with a difference

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Network Operators
Carriers/Enterprises

Vendors*

SDN Researchers
Innovators
Expected Results

Vendors vs. Network Operators

**Vendors**
- Too dependent
  - Incremental approach
  - Break this dependency
  - Create more choices

**Network Operators**
- Address hard technology problems
- Help create solutions that meet your requirements
- Create SDN expertise within your org
- Accelerate SDN adoption
- Reduced time to market; grow market share

**Vendors**
- Address hard technology problems
- Work closely with customers
- Create solutions that customers would deploy

**Network Operators**
- Address hard technology problems
- Help create solutions that meet your requirements
- Create SDN expertise within your org
- Accelerate SDN adoption
- Reduced time to market; grow market share
THANK YOU!
How to Accelerate Adoption of SDN?

**Technology Building Blocks**

- Commodity OF/SDN optimized forwarding devices (switches)
- Distributed SDN Control Plane
- Compelling use cases

**Open Source ONOS Project**

With Network Operators and vendors that are willing to challenge the status quo

To break network operators dependence on a few vendors and create choices ...