Introduction to Software Defined Networking

Ahmed Maged
@amaged
amaged@xegypt.org

MENOG 15 – Dubai – April 2015
Agenda

- What is SDN and What it is not
- SDN Trends
- Getting Ready for SDN
What is SDN

• Simply, it is a new ‘approach’ to networking.
• Which means, it is not just one specific solution, technology or product. It is a range of advances in networking.
• It is a Buzz word that is used for Marketing purposes, to present new new products.
• But there are interesting concepts that are emerging.
What SDN is not…

• It is not ‘only’ decoupling of Forwarding Plane and Control Plane.
• It is not ‘only’ networking on white-boxes / generic hardware.
• It is not ‘only’ programmability support on embedded network devices to program the network.
What is SDN again

- It is a journey of transforming the networking industry, challenging the way we build and manage networks today.
- It is allowing us to easily control the network, in the same way we control applications and operating systems.
- Bringing more flexibility to existing and future networking to influence design and operations from external applications.
- Providing new ways of interaction with network devices.
The Need for SDN

IT: Hi SDN...can you solve my network problems.
SDN: what kind of problems?
More examples:

- Steering traffic and priority based on Weather/Environment changes.
- If a host becomes infected, re-direct their traffic to a portal that will clean their traffic and send them a warning note to their browser.
- i.e.: Allowing granular automatic network changes and routing based directly on Business Metrics and driven from IT Applications.

Why can't I just tell you what I want to do, and you translate it to your language

Error, Command Not Found
Existing technology is limiting us?

• Because the boxes speak protocols/algorithms that are not familiar to other IT personnel and only network people can comprehend…i.e: BGP, OSPF, MPLS…etc

• Because interacting with the network required a language, that a few people in the organization understands…i.e: Vendor specific CLI

• In summary, that always limited what networks can do.

How do I tell you what to do exactly

Learn my CLI + BGP, MPLS, OSPF 😊
Existing provisioning process

- Slow, Time consuming, Human-dependent

New Service or New Employee Hired

Email IT Operations

Network Team to contact Security

Network Team to contact Security

IT to contact Network Team

We forgot to add something

Time Spent: Weeks
Human factor is a bottleneck in business automation.
SDN Addresses needs for

- Centralized configuration, management/control, monitoring of network devices (physical or virtual).
- Ability to override traditional forwarding algorithms to suite unique business or technical needs.
- Allowing external applications or systems to influence network provisioning and operation.
- Rapid and scalable deployment of network services with lifecycle management.
Agenda

• What is SDN and What it is not
• SDN Trends
• Getting Ready for SDN
Evolution

We no longer work in Silos

Evolve from what started as DevOps to NetOps

• Programming technologies married Operations
  – Java, C, Python, REST, Chef, Puppet, OpenStack, Controllers, NetConf/Yang, OpenFlow …

• That fosters innovation and automation
  – Automated provisioning, dynamic traffic engineering, integrated with routers and switches and continuous integration ….

• Combining network operations and development
  – IT and network operations, business application and infrastructure developers

Integrate: Simplify & Automate & Move Fast
Network Function Virtualization
Enablers, benefits and applications

• Technology enabler
  • Hypervisor and cloud computing technology
  • Improving x86 h/w performance
  • Optimised packet processing and coding techniques
  • Network industry standardising on Ethernet
  • SDN based orchestration

• Return on Investment
  • Reduction in CAPEX and OPEX
  • Shorter innovation cycle
  • Improved service agility
Evolving The Network Software Stack

Applications
(End-User and System Applications)

Resource Orchestration & Management

Infrastructure Service Functions

Orchestration Functions

Management Functions

Elementary Infrastructure Functions
(Controller-layer)

Physical and Virtual Infrastructure
(Overlays and Network Function Virtualization)

Application Software

Infrastructure Software

Embedded Software

“open source orchestration functions”

“open source integration layer”
Customer Needs: Network Programmability

- **Research/Academia**: Experimental OpenFlow/SDN components for production networks
- **Massively Scalable Data Center**: Customize with Programmatic APIs to provide deep insight into network traffic
- **Cloud**: Automated provisioning and programmable overlay, OpenStack
- **Service Providers**: Policy-based control and analytics to optimize and monetize service delivery
- **Enterprise**: Virtual workloads, VDI, Orchestration of security profiles

- **Network “Slicing”**
- **Network Flow Management**
- **Scalable Multi-Tenancy**
- **Agile Service Delivery**
- **Private Cloud Automation**
SDN Trends and Programmatic Interfaces

Application Frameworks, Management Systems, Controllers, ...

C/Java Python NETCONF REST

OpenFlow I2RS OpenStack Puppet Protocols ...

Management Orchestration Network Services Control Forwarding Device

API and Data Models

Network Operating Systems

"Extend" "Operate, Configure, Integrate"
Example: Open Source Controller

Open DayLight Controller
What Is OpenDaylight?

• …an open source project formed by industry leaders and others under the Linux Foundation with the mutual goal of furthering the adoption and innovation of Software Defined Networking (SDN) through the creation of a common vendor supported framework.

• Focus: Customers with some programming resources that desire a free, community-supported SDN controller, especially if focus is on OpenFlow
Model Driven Controller Architecture
Controller naturally exposes all APIs: Devices and Network APIs

Northbound API = SUM (Device APIs) + Controller-Services APIs

Automatically generated APIs based on models

Device models loaded into Controller
Application Policy Plugin Architecture

- Application Policy Plugin Framework
- Traditional Network Elements
- RESTCONF
- EP DB
- C DB
- Aff. DB
- IDB
- NETCONF
- CLI
- OF
- "Native"
- Model Endpoint Registry
- Model Contract Composer
- Model Affinity Decomposer
- Model Affinity Service
- Model Inventory
- Model Forwarding Rules Manager

"Native"
Basic Use-Case of OpenDayLight

• Step 1: Query network topology details from the controller using its northbound interface

• Step 2: Create, update and delete paths in the network using the controller southbound interface
Agenda

• What is SDN and What it is not
• SDN Trends
• Getting Ready for SDN
Get Familiar with the Industry Standards + Initiatives

Technical Advisory Group, Working Groups:
Config, Hybrid, Extensibility, Futures/FPMOD/OF2.0

802.1 Overlay Networking Projects

SDN WG
Open Network Research Center at Stanford University

Open Daylight: ODL Controller

Open Source Cloud Computing project

Overlay Working Groups:
NVO3, L2VPN, TRILL, L3VPN, LISP, PWE3
API Working Groups/BOFs
NETCONF, ALTO, CDNI, XMPP, SDNP, I2AEX
Controller Working Groups:
PCE, FORCES
New working group:
I2RS – Interface to the Routing System
Early Adopters and Operational Networks

• AT&T
  http://www.packetdesign.com/blog/att-slow-crawl-to-sdn-ubiquity

• Microsoft :
  http://www.zdnet.com/article/why-microsoft-is-invested-in.opendaylight/

Telefonica :
newsroom.cisco.com/press-release-content;jsessionid=10100EEF9E1CB4FAFCFD6962E824E8E1?type=webcontent&articleId=1488116

• Google :
  http://www.networkcomputing.com/networking/inside-googles-software-defined-network/a/d-id/1234201?

• Amazon:

• Facebook :
Play with the Tools (Controller…etc)

- Find out what are your top challenges that can be solved with SDN.
- Download the tools, build a lab, get trained, test and break things.
- Read tweets and blogs, attend conferences.
- Find out what others are doing.
- Take baby steps, try to automate some things, rinse and repeat.
Get Familiar with new skills

- Every once in a while, engineers need to sharpen some skills.
- This is the time to start the path to a network engineer with software programming and networking hybrid skills.
- Remember the transition from Analog circuit switched networks to IP Telephone ;)

![Image of network cables and a pyramid diagram with steps: Remembering, Understanding, Applying, Analyzing, Evaluating, Creating.]
Get on the bandwagon

• Linux, Sed, Awk
• Automation, Puppet/Chef
• Python, Go Lang, RegEx, Web Services
• Parsing, Pattern matching, JSON, XML
• REST, NetConf/YANG
• Cooperate with the Open source community
Thank you

• Q&A