SDN Approach to Large Scale Global Data Centers

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Welcome!

SDN: The New Frontier

Boldly going where no Network has gone before

But where Servers and Storage have been living…
How Big is Your Data Center?

- 100 End Stations?
- 3200 End Stations?
- 3000000 End Stations?

238,857 end stations

1 MILE
What’s the network to do?

Business as usual?
Data Centers at Large Scale

Configuration & Management

Every network element has Control (C), Management (M), and Data (D) plane.

Complex Protocols

Simply not feasible to manage large networks based on current model.

Very complex to build large scale stable networks.

Server Virtualization adds tremendous complexity to the network.
Why are Networks Inefficient?

**Local View**

- Network is not able to make best use of available resources

**Closed Network**

- Closed networks are hard to change
Has your organization experienced any of the following network operations problems? (Percent of respondents, N=280, multiple responses accepted)

- Too many manual processes: 40%
- Difficulties/delays associated with change and/or configuration management: 36%
- Integration and cooperation between network operations and other IT domains: 34%
- Inability to implement new technology in a timely manner due to a lack of maintenance windows: 29%
- Difficulties and/or delays in provisioning network devices such as servers, switches, and security appliances: 28%
- Inability to implement new technology due to poor coordination between IT administration teams: 26%
- Manual IP address management using tools like spreadsheets: 26%
- We have a heterogeneous network where different technical elements need their own network operations skills and tools: 23%
- Limited skills in the networking team: 20%
- Too many tools: 17%
- We have not experienced any network operations problems: 7%

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Network of the Future

• Easy to scale and manage
• Programmable to meet application needs in real time
• Open standards based programmable network elements
• Presents Network As A Service (NAAS) and Network As An Infrastructure (NAAI)
Software Defined Network: Let’s build a smarter network

- OpenFlow Protocol
- Secure Channel
- SDN Controller
- Forwarding
- VPN
- Security
- BW, QoS etc.
- Network Virtualization
- Load Balancing

Traditional Network Element

- Flash
- Control Plane
- Management Plane
- Memory
- Switching ASIC
- Data Plane
- Transceivers

OpenFlow Network Element

- OpenFlow API
- Data Plane
- Transceivers

IBM
SDN with OpenFlow: An Architecture for Large Scale Networks

**An Analogy**

<table>
<thead>
<tr>
<th>Database</th>
<th>Web Server</th>
<th>Any App You Want</th>
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</thead>
<tbody>
<tr>
<td><strong>OS API</strong></td>
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<tr>
<td><strong>Server Operating System</strong></td>
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<tr>
<td><strong>CPU Instruction Set</strong></td>
<td>add, sub, mul, and, or, xor, neg, lods, stos, movs, scas and cmps</td>
<td></td>
</tr>
<tr>
<td><strong>Server Hardware</strong></td>
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<table>
<thead>
<tr>
<th>Network Virtualization</th>
<th>Intelligent Load Balancing</th>
<th>Any App You Want</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network OS API</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Network Operating System (SDN Controller)</strong></td>
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<tr>
<td><strong>OpenFlow Instruction Set</strong></td>
<td>Match, Add, Modify, Translate, Forward, Drop</td>
<td></td>
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<tr>
<td><strong>Network Element Hardware</strong></td>
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**Open Programmable Network**
SDN: Simple, Scalable Network Management

- Standard based homogenous network
- Each element has same configuration, management and control interface
- Automated configuration, management and control of the network
- One touch point (SDN Controller) versus thousands of touch points (Network Elements)

- Greatly reduce OPEX cost of the network
- Greatly reduce network management complexity
- Greatly reduce network downtime
SDN: Smarter Network for Large Scale Deployment

Global Network View

- Real time network statistics
- Real time network state
- Real time network link usage
- Real time network element state

• Global view of the network allows for
  • quick network convergence
  • Efficient use of all available bandwidth
  • Easy addition or removal of network capacity

SDN Controller

OpenFlow

global topology view

global link state
SDN: Virtualizing the Network

SDN Virtualization Plane
- OpenFlow virtualization of physical network infrastructure
  - Wire once physical network
  - Program as per business needs

Network As An Infrastructure
SDN: Cloud Multi Tenancy – Build for Scale
SDN: Smarter use of Network and Appliances

- Appliance sharing lets network providers use the resources more effectively.
- A very important attribute for large scale Data Centers.
OpenFlow Based SDN for Large Scale Data Centers

- **Multi Tenancy**
  - Efficient use of network resources: Better CAPEX and OPEX savings

- **Self Provisioning**
  - Support large and diverse customer base

- **Programmable Network**
  - Meet customer SLAs with confidence

- **Complete Network Control**
  - Provide network services to meet application needs

- **Uniform Network Management**
  - High network availability

- **Uniform Cloud API**
  - Uninterrupted, seamless service between private and public cloud
SDN in the WAN
for
Large Scale Global Data Centers

Amit Agarwal, Google
No man is an island

datacenter
Agenda

- Trends
- User requirements
- SDN Benefits
More global and a lot more users
Smarter and powerful end points

- As powerful as desktops few years ago
- 4G, HD videos, high resolution camera, NFC chips, …
- Ubiquitous
- Disposable

Lots of cellphones, too few toilets – Indian Census 2011
Apps & Services
More, more and more data
User Requirements

Fast & Interactive

Free or Low Price

24x7 availability

Faster Connection
Move data closer to users

Lower cost of running service

High availability
Software Defined Networking

- Control plane decoupled from data plane
- Standard protocol for information exchange
Network Devices (Data Plane)

- Simpler
- More Scalable
- Easier deployment & upgrades
- Lower Capex and Opex
- Higher availability
OpenFlow (Information Exchange Protocol)

- Interoperability
- Choice of gear from multiple vendors
- Decouples network device from management/control software
Network OS
(Management/Control Software)

- Centralized Management
- Global Optimization
- Application Driven Networking

- Lower downtime and Opex
- Higher utilization
- More network services
Summary

SDN has huge potential
- Better network management
- Higher utilization and availability
- Unleash innovation in network services
Enjoy the ride!

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