WELCOME

Chicago Juniper Users Group

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THE SDN OPPORTUNITY

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WHY SDN NOW?
SOFTWARE TRENDS AND TECHNOLOGY DEMANDS

Software Unification
Unification of the IT organizational silos
+ Devops unification of SW dev & IT ops
+ IT tools defragmentation
  • Collected intelligence
  • SW synergies
  • Lower OPEX
  • Better op. experience

Software Evolution
Software lifecycle mgmt (virtualization)
+ Computing (cloud) to process Big Data
+ Software Design and Architecture Patterns
+ Programmability
  • Integrations
  • Customizations
  • Automations

Tech Proliferation
Mobile Device Connectivity
+ VM Network Connectivity
+ Machine-to-Machine Connectivity
  • Complex Systems
  • High Network Usage
  • Better Traffic Engineering
COMPARING CHALLENGES

The legacy network approach hinders dynamic workflows.
NETWORKING BUSINESS CHALLENGES

OPEX

Complex
- Overly complex to manage
- Difficult to scale
- Difficult to design
- Difficult to understand and analyze

Slow
- Too static
- Manual provisioning
- Slow to respond to business requests
- Slow to validate

Uneconomical
- Rising IT costs with rising complexity
- Declining revenue growth: Difficult to differentiate, monetize and optimize
- SP vs. OTT competition

Closed
- Inflexible
- Monolithic
- Not programmable
- Difficult to integrate
- New Features = New Boxes

Unreliable
- Difficult to secure
- Prone to human error
- Difficult to update while in service

CLOUD

MOBILE

VIDEO
ADDRESSING COMPLEXITY BOTTOM UP & TOP DOWN

SDN-Ready Platforms
Simplified architectures and broad protocol & orchestration support designed for dynamic workloads

SDN-Optimized Operations
Change from element management to workflows
CONNECT EVERYTHING
from Client, through the Network, to the Device

OUR MISSION AND COMMITMENT

EMPOWER EVERYONE
IT DRIVERS: AGILITY AND ECONOMICS
JUNIPER’S SDN STRATEGY: 6-4-1

6 – General Principles

- Separate Layers
- Centralize
- Virtualize
- Open Platforms
- Open Standards
- Apply Broadly

4 – Juniper Steps

- Centralize Management
- Extract Services
- Centralize Controller
- Optimize the Hardware

1 – Licensing Model

JUNIPER SOFTWARE ADVANTAGE

- Full Use and Elastic
- Transferable
- Software Lifetime Assurance
WHAT WE’RE WORKING ON

SDN Building Blocks
- OpenFlow
- PCEP
- BGP
- VXLAN
- Service Chaining
- NFV

SDN Platforms
- JunosV App Engine
- Junos Space
- Contrail

SDN Solutions
- Network Virtualization
- Centralized TE
- Service Automation
- IT Workflow Automation
- Scale Out
- ZTP

Projects & Partners
- OpenDaylight
- OpenStack
- VMware
- ONF
- OpenLab
- CloudStack
**USE CASE: OPTIMIZED TRAFFIC ENGINEERING**

- **Goal:** Maximize the utilization of network infrastructure bounded by certain SLA / QoS metrics.
- Multiple sources of information go into (i) offline capacity planning and what-if scenario simulation exercises with periodic network updates or (ii) real-time event driven resource optimization.
- Infrastructure team is typically the business / buying decision maker (customer cost center – but revenue source for Juniper as they buy large core/edge routers).

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1. Business applications define policy constraints and optimization schedules.
2. Real time topology and link state discovered from the network elements using BGP-TE.
3. Centralized SDN System calculates pan network optimal paths based on defined policy constraints, static topology and real-time network data.
4. Explicit path or route objects pushed to the end point network elements using PCEP.

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**Diagram Elements:**
- DC
- L2 / L3 Packet Core
- Optical Network
- SDN Management System
- SDN Control System
- Workflow Management System
- Backbone
- DWDM / OPT
- P
- PE
**USE CASE: RAPID SERVICE DEPLOYMENT**

**Traditional Mobile Control Gateway**
- MCG ATCA chassis
  - 10M active users
  - 32 ATCA chassis
  - 3 zones (11 ATCA per zone)
  - 300K subscribers per chassis

**Virtual Mobile Control Gateway**
- JunosV App Engine
- MX3D
  - 10M active users
  - 54 VSE appliances (27+27 backup)
  - 3 zones (1 MX 3D/zone)
  - 3.3M users per MX 3D, 400K users per VSE
- X86 appliances

**Financial Benefits**
- 54% lower TCO
- 65% lower OpEx
- 53% lower CapEx

**Development Time & Cost**
- 46% faster initial deployment
- 61% less initial deployment cost
- 87% faster capacity additions
- 92% less capacity addition cost

**Operational Benefits**
- 73% less environmental cost
- 72% less operator training cost
- 63% OA&M cost
USE CASE: VIRTUALIZED DATA CENTER

- Silo’ed Resource Allocation
- Manual Configuration
- Static Service Chains

- Dynamic Resource Allocation
- Automatic Configuration
- Dynamic Service Chains

TCO Reduction
Faster Time-to-Revenue

TRADITIONAL DATACENTERS

- VLANS
- Physical Servers
- Local Hard Drives
- Firewalls
- Load-Balancer

VIRTUALIZED DATACENTERS

- Virtual-Network based Orchestration (Compute, Storage, Apps)
INITIAL APPROACH TO SDN VIRTUALIZATION

REACTIVE END-TO-END NETWORK

- Separates the data plane from the control plane
- Completely centralizes the control plane
- First packet of every flow is punted to the controller - reactive
- Uniform flat network
- Very large forwarding table in switches
- Tenant changes affects all switches in path
- Replaces existing network and protocols
First packet of every flow is punted to controller. Controller reactively programs every flow on every switch on path. Per-tenant state in physical network: Switches contain many flows. High latency. Low scalability. Fragile. Fork-lift upgrade.
BETTER APPROACH TO SDN VIRTUALIZATION

PROACTIVE OVERLAY NETWORK

- Underlay physical network provides industry standard L2 & L3 forwarding
- Tenant state only at the network edge – server hypervisors & gateways
- Controller proactively installs forwarding state
- Much smaller forwarding table in switches
- Tenant changes don’t affect physical network
- Incremental evolution of existing network and protocols
PROACTIVE OVERLAY NETWORKS

Packets are not punted to controller

Controller proactively programs virtual overlay switches & gateways only

No per-tenant state in physical network: Switches only know physical servers

Existing protocols establish IP fabric underlay

Low latency. High scalability. Robust. Evolutionary.
OVERLAY ARCHITECTURE

BUILT FROM THE GROUND-UP FOR:

Always-On, Carrier-Class Cloud
- No five or seven nines, its always available!
- In-service upgrade without any downtime
- Scale out without the management burden

Multi-Cloud Federation & Scalability
- Seamless interoperability with existing physical equipment
- Federation within clusters, across autonomous systems (hybrid clouds) over large scale

Agility and Innovation
- Preserves existing investment in networking
- Enables abstraction and programmatic APIs required for the dynamism of new applications
CONTRAIL CONTROLLER

SDN Controller

Configuration  Analytics  Control

Orchestrator

Server
 VM  VM  VM

IP fabric (underlay network)

Tenant VMs

KVM, Xen or HyperV Hypervisor + Contrail vRouter (L2 & L3)

Juniper Qfabric/QFX/EX or 3rd party underlay switches

Juniper MX or 3rd party gateway routers

Contrail Controller

Juniper MX
Qfabric
QFX/EX

or 3rd party underlay switches

openstack
redhat
cloudscaling

KVM, Xen or HyperV Hypervisor + Contrail vRouter (L2 & L3)

Juniper MX
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CONTRAIL CONTROLLER

**SDN Controller**
- Configuration
- Analytics
- Control

**Server**
- VM

**IP fabric**
(underlay network)

**MPLS over GRE or VXLAN**

**Orchestrator**

**BGP Federation**

**REST**

**XMPP**

**BGP + Netconf**

**BGP Clustering**

**Tenant VMs**
- KVM, Xen or HyperV Hypervisor + Contrail vRouter (L2 & L3)

**Juniper Qfabric/QFX/EX or 3rd party underlay switches**

**Juniper MX or 3rd party gateway routers**

**Control**

**Federation**

**Clustering**

**Contrail Controller**
STANDARDS

Overlay control plane protocols:
- XMPP: RFC 6120, draft-marques-l3vpn-end-system
- BGP L3VPN: RFC 4364
- BGP EVPN: draft-ietf-l2vpn-evpn
- NetConf: RFC 6241
- Multicast: draft-marques-l3vpn-mcast-edge

Overlay data plane encapsulation:
- MPLS over GRE: RFC 4797
- VXLAN (encapsulation only): draft-mahalingam-dutt-dcops-vxlan

Underlay control plane protocols:
Existing layer-2 or layer-3 protocols

Overall architecture
- IETF NVO3 WG
- ETSI NFV ISG
Overlay establishes a serial, “chain” through multiple virtualized services.
**SERVICE CHAINING**

**Customer Deployment Advantages**

- Cloud agility and economics for network services (NFV)
- Uniform templates for deploying any in-network services
- Decouple service from routing infrastructure
- Carrier-grade routing without the complexity of the routing protocols or manual configurations
- Meet dynamic systems requirements with RESTful APIs for chains creation, service sequencing, and service scaling for customized integrations with

Overlay establishes a serial “chain” through multiple virtualized services
- vNetwork to vNetwork, VM to VM, or combinations thereof