TUTORIAL:
WHITE BOX/BARE METAL SWITCHES

Rob Sherwood
CTO, Big Switch Networks
Open Network User’s Group: May, 2014
OUTLINE

• Motivation
• Ecosystem and Terminology
• Support and Purchasing
• Available Hardware
• Available Software
  • Open Network Install Environment (ONIE)
  • Commercial
  • Open Source
• Hand over to Sean Varley: NFV
WHO AM I: ROB SHERWOOD

- CTO, Software architect at Big Switch Networks
- ONF: former chair of ArchWG and vice-chair of TestingWG
- Working in OpenFlow/SDN since 2008
- Campus Network admin of yore
MOTIVATION
EVOLUTION OF NETWORK PROVISIONING: 1996-2013

**1996**

```
Router> enable
Router# configure terminal
Router(config)# enable secret cisco
Router(config)# ip route 0.0.0.0 0.0.0.0 20.2.2.3
Router(config)# interface ethernet0
Router(config-if)# ip address 10.1.1.1 255.0.0.0
Router(config-if)# no shutdown
Router(config-if)# exit
Router(config)# interface serial0
Router(config-if)# ip address 20.2.2.2 255.0.0.0
Router(config-if)# no shutdown
Router(config-if)# exit
Router(config)# router rip
Router(config-router)# network 10.0.0.0
Router(config-router)# network 20.0.0.0
Router(config-router)# exit
Router(config)# exit
Router# copy running-config startup-config
Router# disable
Router>
```

**Terminal Protocol:** Telnet

---

**2013**

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```

**Terminal Protocol:** SSH

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BUT HARDWARE VERTICALLY INTEGRATED HOLDS US BACK
Vertically Integrated Systems Have Changed Little Over the Past 15 Years

Provisioning and Management
- Static, manual configuration
- Low feature velocity

Operating Systems
- Few API’s, only CLI (closed OS)
- Not externally programmable

Hardware Systems
- Lock-in to a particular vendor

System Silicon
- Slow innovation cycles
- Expensive, no economies of scale

Feature 1
Proprietary Network OS
Proprietary System
Proprietary Silicon

Feature 2
THREE REASONS TO BUY BARE METAL

1. Choice: avoid vertical lock-in

2. Lower OpEx: better fit your needs

3. Lower CapEx: horizontal competition
ISN’T NETWORKING ALREADY OPEN?

Faster Throughput = More commercial value = More Proprietary

Aggregate Throughput →

- X86 Servers
- NPU, FPGA, SoC
- DC – 1U ToRs, Spines
- Multi-chassis Routers

All Hardware Specs Public
Binary SDK for Packet Forwarding
Closed OS, Open Control Plane APIs
Closed OS, Open APIs for Policy, Stats

Open

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ISN’T NETWORKING ALREADY OPEN?

Faster Throughput = More commercial value = More Proprietary

Aggregate Throughput

X86 Servers

NPU, FPGA, SoC

DC – 1U ToRs, Spines

Multi-chassis Routers

10 Gb/s

100 Gb/s

1 Tb/s

10 Tb/s

Open

All Hardware Specs Public

Binary SDK for Packet Forwarding

Closed OS, Open Control Plane APIs

Closed OS, Open APIs for Policy, Stats

This talk
ECOSYSTEM AND TERMINOLOGY
WHAT’S INSIDE A SWITCH?

Application

Network OS

Hardware Driver

Box

Silicon
COMPONENT ECOSYSTEM AND BARE METAL

**Application**

- Single Vendor
- Closed Product

**Network OS**

- Single Vendor
- Closed Product

**Driver**

- **Traditional Networking** (past)
- **Traditional Networking** (today)

**Box**

- **Vendor**
  - ODM Box
  - ODM Chip

**Silicon**

- **Bare Metal Vision**
  - ODM Box
  - ODM Chip

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SERVER ECOSYSTEM IS MATURE, HORIZONTAL
Open Architecture – Choice of Vendors – Innovation Velocity – Low TCO

- Apache
- MySQL
- Nagios
- Custom Web App
- Hadoop
- etc.

Applications
- 3rd party or Custom

Operating System
- Open or closed source
- Virtualized or bare metal
- Many support models

Hardware Systems
- Fierce competition
- Branded or “white box”

System Silicon
- Competition and rapid innovation

- Linux
- Windows
- VMware
- KVM
- Xen

- Dell
- HP
- Super Micro

- Intel
- AMD

“Bare Metal” Server

“Bare Metal” Server

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"BARE METAL" MEANS BUYING JUST THE HARDWARE

No vertical integration – just like how we buy our servers

SDN Apps | Traditional
---|---
OpenFlow | OSPF | BGP
| STP | IGMP

BSN Switch Light | Pica8 | Cumulus

Quanta | Celestica
| Accton | Delta | Alpha
| Broadcom | Mellanox | Marvell | Centec | Intel

Application
- Re-create existing distributed protocols
- New SDN-based applications

Network Operating System
- Open or closed source
- New Ecosystem

ODM and Brand Name Companies

Merchant Silicon
- Growing number of startups!

“Bare Metal” Switch
“BARE METAL” IS MORE THAN WHITE BOX
Both white box and brand name vendors can support bare metal switches

<table>
<thead>
<tr>
<th>Brand Name</th>
<th>White Box</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell</td>
<td>No Name</td>
</tr>
<tr>
<td>HP</td>
<td>SuperMicro</td>
</tr>
<tr>
<td>IBM</td>
<td>Quanta (...)</td>
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Will brand name **server** vendors become brand name bare-metal **switch** vendors?

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</table>
Dell Open Networking Model
Offers open, innovative and best of breed solutions for the data center

- Standard orchestration and automation tools
- Optional 3rd Party SDN / NVO controller
- Any OS
- Open Networking switch
- Merchant silicon

Big Switch Big Tap & Cumulus OS are complementary & unique solutions

- Networking for Unified mgmt of servers & switches for Linux savvy customers
- For Monitoring fabrics – capture growing market driven by Cyber attacks & application performance
- Dell’s rich, full-featured OS architected for performance, resiliency and portability across switch platforms

S4810-ON 1/10/40 GbE switch
S6000-ON 10/40 GbE switch
SAME BOXES, DIFFERENT LABELS

- ODMs directly supply traditional networking vendors
  - Probably boxes you’ve already deployed
- Each ODM created new public face/commercial label
  - To create appearance of not competing directly

<table>
<thead>
<tr>
<th>ODM Manufacturer</th>
<th>New Vendor Company</th>
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<tbody>
<tr>
<td><img src="image" alt="Quanta" /></td>
<td><img src="image" alt="iW Networks" /></td>
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SUPPORT AND PURCHASING
PURCHASING AND SUPPORT: SERVERS
Server Support Ecosystem Has Evolved to Fit Business Needs

By a show of hands...

• **Where do you buy your server hardware:**
  • Direct from hardware vendor? Partners? VAR?

• **Where do you buy your server OS and applications?**
  • Direct from software vendor(s)? Partners? VAR?

• **Who do you call if there is a problem?**
  • Software or hardware supplier? Or a VAR?
<table>
<thead>
<tr>
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## PURCHASING AND SUPPORT

Just like a servers: many choices

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Purchasing and Support

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SUPPORT PROGNOSTICATIONS

• Which support process will dominate?
  • Rapidly evolving: our customers use all of these
  • Depends on geographic region: Japan → VAR, EMEA → partner, US → direct
  • **Claim**: “Single throat to choke” will transition to VAR then direct sales.

• Software Licenses: **subscription** versus **perpetual plus support**
  • Depends on company size, internal accounting
  • “Both” may be the right long term answer
  • Larger question than networking software
AVAILABLE HARDWARE
SIMPLIFIED HARDWARE PURCHASING

Streamlined Procurement

Transparent Pricing
SURPRISINGLY LOW CAPEX

32x40G for ~$10K
==
$312/40G port

~$6k – 4x40G@$312
==
$99/10G port
OUTLINE

• Motivation
• Ecosystem and Terminology
• Support and Purchasing
• Available Software
  • Open Network Install Environment (ONIE)
  • Open Source
  • Commercial
• Hand over to Sean Varley: NFV
OPEN NETWORK INSTALL ENVIRONMENT (ONIE)

• Open source project to install/uninstall network OS
  • http://github.com/onie/onie or http://onie.github.io/onie/

• Think of it like a hybrid PC BIOS and Grub/LILO/Sysimage

• Co-operative project: OCP, Cumulus, Big Switch, Others
  • In practice: Curt Brune from Cumulus Networks does almost all of the work

• Allows a network admin to install/uninstall a network OS
  • In practice, it is itself a ~4MB mini-Linux installation
COMMERCIAL BARE METAL SWITCH SOFTWARE
This is not a product pitch talk – talk to me afterwards.

- Traditional Control Plane
  - Cumulus Linux
  - Pica8’s PicOS

- SDN Control Plane
  - Big Switch Networks’s Switch Light OS
OPEN SOURCE: OPEN NETWORK LINUX
A Linux distribution for bare metal switches

• Open-sourced commercial code, build scripts, drivers from Switch Light
  • Part of Open Compute Project (OCP)
• Project goals:
  • Improve perception/de-risk bare metal
  • “Crowd source” larger Switch Light HCL
• Released mid-January: Initial results
  • Strong community response from ODMs, OCP
  • Accton self-supporting three new boxes, more ODMs interested
  • Other vendors investigating ONL for their own purposes
  • Info: http://opennetlinux.org – under construction
ONL – SUPPORTED HARDWARE
X86 versus PPC Discussion

<table>
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<tr>
<td>Because of the HTML formatting, this page may be best viewed from <a href="http://opennetlinux.org/hcl">http://opennetlinux.org/hcl</a></td>
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**Quanta/IW Networks**

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<td>QuantaMesh T1048-LB9</td>
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<td>Broadcom BCM5534 (Firebolt3)</td>
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<td>48x10G + 4x40G</td>
<td>P2020</td>
<td>Broadcom BCM56846 (Trident+)</td>
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**Accton/Edge-Core**

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<td>Accton AS4600-54T</td>
<td>48x1G + 4x10G</td>
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<td>Broadcom BCM56540 (Apollo2)</td>
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<td>Accton AS6700-32X</td>
<td>32x40G</td>
<td>P2041</td>
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**DNI/Agema**

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<tbody>
<tr>
<td>AG-7448CU</td>
<td>48x10G + 4x40G</td>
<td>P2020</td>
<td>Broadcom BCM56845 (Trident)</td>
<td>Supported and Tested</td>
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</table>

- **ONL Support is Pre-cursor to Switch Light Support**
- **Working on OCP box from Interface Masters with x86 support**
**Switch Light Architecture**

Legend:
- Open Network Linux
- BSN Open
- BSN Closed
- 3rd Party Closed Source

**Switch Light OS**

- ZTN Loader
- SSH
- Fan Control
- NTP
- Syslog
- SNMP
- LibC on Debian Wheezy Base Distribution
- ONL Linux Kernel
- I2C
- GPIO
- Device Trees
- ASIC SDK
- ASIC

**Legend**
- Big Network Controllers
- OpenFlow Agent
- CLI
- Indigo
- Loxi
- Indigo/ASIC Driver

**Switch Light** is our Indigo OpenFlow Agent running on Open Network Linux on x86 or ASIC-based hardware.

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CONCLUSION
CONCLUSIONS

• Traditional network vendors have outsourced much of their hardware: box and ASICs
• Buy/support/run your network like your servers
• Growing ecosystem
  • Silicon: Broadcom, Intel, Marvel, Centec, etc.
  • Hardware: Dell, Accton, Quanta, Agema, etc.
  • Software: Big Switch Networks, Cumulus, Pica8

1 Choice  2 Lower OpEx  3 Lower CapEx