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Networking: Software

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Open Networking (white box) in the Enterprise

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Why am I here?

To share Open Networking experiences from an enterprise perspective (non hyperscale)

Matt Turner Bio

- CCIE 16857 (Emeritus) Routing and Switching
- Data Center Network Manager at Qualcomm Inc.

Qualcomm Network Bio

- 30+ data centers (~850 switches, spine/leaf topologies)
- Many LAN & LAB switches (~2700)
- Dedicated "NetDevOps" team 😳





NETWORKING

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What is Open Networking?

- Disaggregation, White Box, VNF's, controllers, ONF?
 - Depends who you're talking to.
 - For Qualcomm, Open Networking is White/Brite Box+ONIE+Software
- ONIE = Open Network Install Environment (OCP open source initiative)
 - Cumulus
 - Big Switch Monitoring Fabric
 - OpenSwitch (OPX)
 - SONic
 - JunOS



Why Open Networking

- \$uper exciting!
 - Roughly 33% the cost of traditional networking
 - (discounted rate)
- Disaggregation allows flexibility
 - Big Switch BMF and Cumulus today, tomorrow?
- Linux is easier to automate than Cisco/Arista/Junos/etc
 - Ansible/Chef/Puppet built for Linux, adapted for networking
- Great way to transition from pets to cattle approach for network switch provisioning and MGMT
- Open Linux platform (install collectd if you like...)



Lots of Lab Testing and Evaluation...

- Decided on Cumulus for networking, Big Switch Monitoring Fabric
- Cool network features
 - BGP/OSPF Unnumbered (IPv6 link local peering)
 - BGP Redistribute Neighbor (redistribute ARP table into BGP /32 routes)
 - Cumulus NCLU (meh... for some, CLI alternative for others)
- Cool monitoring fabric features
 - OpenFlow (behind the scenes) controller based
 - ZTP/DHCP capable

What About Hardware?

- Common hardware on vendor HCL's
- Keep spares in stock vs purchasing hardware support
- Support for many brands of optics and cables
- Same chips, CPU as traditional vendors
 - Broadcom ASICs, Intel or AMD CPU, etc.



Building Blocks for Success

- ONIE, Zero Touch Provisioning (ZTP)
 - ONIE boot, ZTP using DHCP options and default URL (114)
- Git, GitHub
 - Version control for ZTP, operations playbooks, global switch configurations
- Jenkins
 - CI/CD platform for centralized Ansible controller
 - Splunk logging, RBAC, store credentials, cron, GUI!
- Ansible (or Chef, Puppet, Salt)
 - We prefer Ansible for use with legacy vendor hardware/OS (agentless)

Framework – GitHub/Jenkins/Ansible

- Initially deployed for Open Networking (Cumulus)
- Playbooks stored in GitHub for version control, change MGMT, and code/peer review
- Playbooks run from Jenkins for centralization, security, auditing, logs, etc. (logs all jobs and results to Splunk)
- Ansible and associated plugins/modules installed on Jenkins server



What We Automate

- Almost everything...
- ZTP for bring up
 - DHCP MAC reservation, DHCP default URL for image load
- Ansible for initial configuration
- API for user self service (rack and stack team, server/storage admins)
 - Add/change VLANs for access ports
 - Create MLAG
 - Add/change VLANs for existing MLAG ports
- Ansible for weekly global configuration compliance (declarative, no audit needed)
 - E.g. NTP servers shall be x, y, z

Do Automation Day One!

Zero Touch Provisioning

subnet 192.168.0.0 netmask 255.255.255.0 {

range 192.168.0.20 192.168.0.200;

option domain-name-servers 192.168.0.2;

option default-url = "http://10.0.0.10/customer-abc-onie-installer";

ONIE Boot – ZTP

Info: Mounting ONIE-BOOT on /mnt/onie-boot ... Info: Mounting EFI System on /boot/efi ... Info: Using eth0 MAC address: 3c:2c:30:38:ed:00 Info: eth0: Checking link... up. Info: Trying DHCPv4 on interface: eth0 ONIE: Using DHCPv4 addr: eth0: 10.1.19.221 / 255.255.255.224 <SNIP>

Please press Enter to activate this console. Info: eth0: Checking link... up. Info: Trying DHCPv4 on interface: eth0 ONIE: Using DHCPv4 addr: eth0: 10.1.19.221 / 255.255.255.224 ONIE: Starting ONIE Service Discovery Info: Fetching http://10.43.255.182/cumulus/cumulus-linux-3.7.0-bcm-amd64.bin ... [21.497593] random: crng init done ONIE: Executing installer: http://10.43.255.182/cumulus/cumulus-linux-3.7.0-bcm-amd64.bin Verifying image checksum ...OK. Preparing image archive ... OK. <SNIP>

Please reboot to start installing OS. ONIE: NOS install successful: http://10.43.255.182/cumulus/cumulus-linux-3.7.0-bcm-amd64.bin ONIE: Rebooting...

Jenkins Framework Jenkins Ansible-Cumulus ansible-cumulus-switch-deploy Back to Dashboard Project ansible-cumulus-switch-deploy Q Status ansible-cumulus-switch-deploy / main.yml Branch: master -Deploy new Cumulus switch configuration 🥟 Changes Workspace (++) mattt Update main.yml Build Now Workspace S Delete Project 2 contributors 11 (Configure Recent Changes 🔄 Email Template Testing 203 lines (165 sloc) GitHub 5.1 KB **Permalinks** > Splunk Last build (#105), 1 day 7 hr ago - hosts: cumulus 1 Last stable build (#105), 1 day 7 hr ago 🥟 Rename gather_facts: no 2 Last successful build (#105), 1 day 7 hr ago • Last failed build (#102), 9 days 7 hr ago 3 tasks: Last unsuccessful build (#104), 1 day 8 hr ago Build History trend - Last completed build (#105), 1 day 7 hr ago 4 find 16:07:02 changed: [san-af145-sbx-sw-c501] 16:07:02 changed: [san-af145-sbx-sw-c502] 16:07:02 16:07:02 changed: [san-af145-sbx-sw-c501] **16:07:02** changed: [san-af145-sbx-sw-c502] 16:07:02 16:07:02 PLAY RECAP ***** changed=24 **16:07:02** san-af145-sbx-sw-c501 : ok=24 unreachable=0 failed=0 **16:07:02** san-af145-sbx-sw-c502 changed=24 failed=0 : ok=24 unreachable=0 16:07:02 16:07:02 No emails were triggered. 16:07:02 Finished: SUCCESS

Day Two Automation – Self Service Tools

Home > Interfaces > ITOS Management

ITOS

Device Hostname:

Search

Save Changes Cancel						
Name	Description	VLAN	Config Speed	Op Speed	Op Status	Admin Status
bridge					up	ир
eth0	OOB_MGMT				ир	up
swp1	BLCAF155-C9-1A	550			ир	up
swp2	BLCAF155-C9-2A	550			ир	up
swp3	BLCAF155-C10-2A	550			up	ир
swp4	BLCAF155-C10-1A	550			up	up
swp5	oa-blcaf155-waves01a-new	550			up	up
swp6	daniel_testing_itos-2	116 10.53.116.0/22_AFDC_ILO		•	down	down
swp7	daniel_testing_itos-2	130 10.52.130.0/23_AF155_NET_SERVER		•	down	down

Obstacles to Overcome

- "Where's my config-t?"
- Upper MGMT directors are/were CCIE's, "Who do I call for support?"
- Legacy Network Management and Monitoring Tools
 - RSA/ACS challenging to set up at first
 - SNMP mostly works
 - Config Repo (HPNA Opsware for Cisco/Arista, GitHub/Jenkins for Cumulus)
- Change in mindset from a single config file, to Linux "net-sysadmin"
 - IMO this evolution needs to occur anyway for OpenStack, K8s, etc.. (Linux networking)

Non-Critical and Simple Deployments First

- OoB Data Center Network (switch mgmt.)- copper
- OoB Server Network (iLO/DRAC/MGMT) copper
- Lab/Test/Dev Environments fiber and copper
- LAN Access copper PoE for fun and testing (works fine)
- Simple Critical Environments HPC-LSF Top of Rack
 - Only requires BGP, LACP, MLAG
 - 80-96 servers per rack
 - QSFP Twinax cables to 4x25G SFP+

Test Network

- Have at least one...
- Vagrant/VirtualBox works well for us
 - Pre-canned topologies, stored in GitHub/GitLab
 - Great for learning, testing, planning for changes, developing automation
- Physical lab setup for optics, monitoring, etc. testing

Lessons Learned

- Adoption can be tough for seasoned network engineers
 - Need to learn Linux, Git/GitHub version control, CI/CD tools like Jenkins
 - Should learn Ansible/Puppet/Chef
 - Need to let go of the "config t"
- Linux experience very beneficial
- Automation required, day one
- Cattle instead of pets mindset
- Switch VM's are great learning and testing tools
- <u>https://github.com/mattincarlsbad</u>

Conclusion

- Enterprises can:
 - Deploy and run white box switches
 - Save money by doing so
 - Usher in the new era of Linux networking
- As long as they...
 - Start in the lab
 - Start small
 - Don't expect "config t"
 - Keep an open mind

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OCP Global Summit | March 14–15, 2019

