

SONIC at Comcast Datacenters

(Software for Open Networking in Cloud) *Think Outside of Cloud*

Alankar Sharma
 Sr. Principal Architect, DC Networking
 Comcast

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- Vincent Celindro Globals Architect - Networking



Agenda

- Comcast Datacenter Network Overview
- Current Challenges & Motivation for New NOS: SONIC
- ➢ What is SONiC?
 - BYO Container Apps
 - SONiC Subsystem
 - BGP Update Processing
- SONiC Maturity
- > SONiC Benefits
- SONiC at Comcast
 - Current State of Deployment
 - o Features
 - o Roadmap
- Comcast DC Quad Design
- DC Core running SONiC
- Monitoring & Management
 - Telemetry & Data Sources
 - Grey Failures: ML Based Anomaly Detection
- Advanced Features: Fast Reboot CLI Demo



Comcast DC Network Overview

Large Footprint

- 8 National DC
- 14 Regional DC
- 54 Local DC

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- 8 Syndication DC
- 4 Video Distribution DC
- + POPs and Head Ends

Complex Eco-system

- 9500+ Network device
- 300,000 server ports
- 600+ Changes/mo
- Multi Vendor: 8+ vendors for n/w infra
- 117 Hardware Models
- 184 versions of NOS Images
- MGMT Tools- (you name it!) -CVP, JunOS, DCNM, HPNA, TAIL-f, Home Grown



Comcast DC Network Overview

- Heterogeneous Infra types- Various Cloud Platforms (OpenStack, VMW, CaaS, Cloud Foundry), Storage Systems, Voice Systems, Baremetal Servers, Video Systems, Appliances, Legacy Appliances
- Applications: Video, Multicast, DVR, Encoders, Big Data, Voice, HSD, CDN, X1
- Security (Permissions, Access Control, Asset protection, Copyrights), PCI/PII Zones- DMZ, Internal, PCI Sensitive, Office (IT)
- Unlike web-scaler cookie-cutter, but more customized, siloed deployments due variety of applications and appliances
- Virtualized but considerable Baremetal servers



Why a new NOS at Comcast? Our Motivation

What if the whole world spoke just English...

- Automation Challenges: Needed to build an abstraction layer that can consume common templates and services. Attempts were made with Tail-f and OpenConfig
- Normalize the hardware variations. Empower to share same configuration, provisioning and mgmt tools
- Minimize the software interop issues, even with same vendor
- Reduce cost. Pay only where you need to. Lean DC core and features pushed down to the edge. (Avoid any bandwidth-based NOS charges)
- Break-free: No more hostage to vendors. Feature Velocity and portability
- Multi-Vendor and Chip Diversity

- Decouple not only the HW/SW, also the SW/SW (containers)
- Commercially supported but easy to pull the plug, unlike proprietary NOS. And no perpetual license baggage.



What is SONiC?

Software for Open Networking in Cloud

- Linux software and integration.
 Full interaction with native Linux shell
- Strong and growing support from ODM and ASIC vendors
- SAI (Switch Abstraction Interface): Hardware independent
- Containerized Network Apps
- Advanced management tools





BYO Container Apps

- Components Isolation
- Select Building blocks
- Easy deployment
- Transactional

Benefits

- Serviceability
- Extensibility
- Development agility





SONiC Subsystem

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Ref Link: https://github.com/Azure/SONiC/wiki/Architecture

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BGP Routing Innerworkings Example

- 1. Neighbor sends new BGP prefix as an update, which is received at BGP's socket in kernel
- 2. BGP socket propagates the update to the bgpd process
- 3. BGPd interprets the update and notifies Zebra of the new route
- 4. Zebra validates the new route and delivers the netlink-route message to fpmsyncd
- 5. fpmsyncd updates the APP DB
- 6. Orch Agent, subscribes to APP DB, realizes the state change
- Orch Agent, processes the updates of the App DB and do corresponding changes in the SAI DB via SAI Redis.
- 8. Syncd receives the new state, generated by the orchagentd
- 9. Syncd uses SAI API to push the route into ASIC via the ASIC driver

Ref Link: http://azure.github.io/SONiC/



SONiC Maturity

- Community Ecosystem
 - 3 releases per year
 - 120-250 commits/months
 - ~850 community members
 - ~200 active code contributors
 - 68+ supported platforms
- Monitoring Tools Available
- Proven Management Tools
- Major Customers are running it in Prod
 - Contributing & Hardening
 - Ali Baba, Tencent, Linkedin, Dell, Broadcom, Mellanox
- Commercial Support Available





SONiC Advantages

- Designer NOS: Operators can select best building blocks. Containerization gives choice of per component level. E.g. BGP- FRR, Quagga, GOBGP, Arista BGP, Juniper CRPD
- Not everyone has high negotiation power. SONiC is same cost for all, favoring small-mid size companies
- No carry forward baggage from monolithic codes
- Dedup: All NOS vendors are building same L2/L3 stack
- Zero downtime upgrade through docker swarm, patches in hours and new features rolled out quickly
- Hitless upgrades: Upgrade thousands of switches in a day
 - Fast Reboot, Warm Reboot
- CI/CD practices



SONiC Comcast Deployment

- Deployed in DC Lean Core (v4/v6 L3 underlay)
- Team: Five engineers + Ops (24/7) as the team to manage/deploy
- Plans to expand into Leaf Layer
- Deployed Features BGP, ECMP, LAG, SYSLOG, LLDP, DHCP, TACACS, CoPP, IPv6, Fast Reboot, Everflow, Telemetry, Warm Reboot, ACL, NTP (Unlike other vendor NOS with monolithic codes)
- Roadmap (Testing)
 VLAN, VLAN Trunk, VxLAN, VRF, MLAG, sFLOW, BGP EVPN, INT
- Desired BGP Unnumbered





Comcast Datacenter (HLD)

SONIC in DC Core



SONiC Monitoring and Management



- Augtera Networks provides AI based network monitoring with SONiC integration
- Machine learning based real-time anomaly detection and auto-correlation along with notifications
- Ad-Hoc queries on real-time and historical data to troubleshoot incidents and analyze impact to customers / applications
- On demand or AI triggered flow collection and analytics leveraging Everflow*



Telemetry





SONiC Data Sources Leveraged

Data Type	API Type	Notes
Network Topology	SNMP	L2 and L3
System Events	Syslog	
Control Plane State & Metrics	SNMP	Comcast is using BGP
*Sensor data (<i>Roadmap</i>)	Sonic GRPC based Telemetry streaming	CPU, temperature, fan speed etc.
Port counters	Sonic Telemetry streaming	inPackets128To255Octets ,inOversizePacket, outOversizePackets, inBroadcastPackets, ifInDiscards, ifInErrors, inMulticastPackets, ifHCInOctets, inUnicastPackets, inUnknownProtos, outBroadcastPackets, ifOutDiscards, ifOutErrors, outMulticastPackets, ifHCOutOctets, outUnicastPackets
Queue counters	Sonic Telemetry streaming	queueStatPackets, queueStatBytes, queueStatDroppedPackets, queueStatDroppedBytes
*Buffer Statistics and Tracking (BST) (<i>Roadmap</i>)	Sonic Telemetry Streaming	Coming soon Buffer count and queue entries for port-priority-group, service-pool, port-service-pool and queue categories Top-drops, top-port-queue-drops, port-drops, port-queue-drops
*Packet Telemetry	Sonic Everflow	On demand and AI triggered
(Roadmap)		
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ML Based Anomaly Detection with SONiC

- Grey failures and traffic anomalies detection using Augtera AI Network Pulse
- No thresholds configured (e.g., BST thresholds)
 - ML learns the patterns and automatically triggers anomalies on anomalous queue utilization or drops
- Congestion detection benefits from existing and additional counters in the roadmap
 - Port counters: Finds anomalies on traffic, discards, oversize packets and 128To255Octet packets
 - -Queue counters and BST metrics are in progress



CLI/Demo Screenshots

- Fast Reboot Minimal Disruption (30 Seconds)
- Warm Reboot Sub-second Disruption



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DEMO Setup





Setup in Default State- iperf initiated from window 1

root@sjc-z9100-01:~#	root@sjc-z9100-02:~#
root@sic-z9100-01:~#	root@sjc-z9100-02:~#
root@sic-z9100-01:~#	root@sjc-z9100-02:~#
root@sic=z9100-01:~#	root@sjc-z9100-02:~#
	root@sjc-z9100-02:~#
	root@sjc-z9100-02:~#
	root@sjc-z9100-02:~#
	root@sjc-z9100-02:~#
root@sjc-z9100-01:~#	root@sjc-z9100-02:~#
root@sjc-z9100-01:~#	root@sjc-z9100-02:~#
root@sjc-z9100-01:~# show ip route	root@sjc-z9100-02:~#
Codes: K - kernel route, C - connected, S - static, R - RIP,	root@sjc-z9100-02:~# show ip route
O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,	Codes: K - kernel route, C - connected, S - static, R - RIP,
> - selected route, * - FIB route	O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,
	> - selected route, * - FIB route
C>* 10.1.0.1/32 is directly connected, lo	
B>* 10.1.0.2/32 [20/0] via 150.0.0.1, Ethernet0, src 10.1.0.1, 00:17:39	B> 10.1.0.1/32 [20/0] VIA 150.0.0, Ethernet0, SFC 10.1.0.2, 00:17:43
C>* 100 0 0 0/24 is directly connected. Ethernet120	CX 10.1.0.2/32 is difectly connected, io
Cost 127 0.0.0/2 is directly connected, lo	K/ 100.0.0.0/24 Via 100.0.0.0, Etherheto
Critic 127.0.0.0/21 is directly competed. The method	CA 12/.0.0.0/0 is directly connected, 10
C> 150.0.0.0/31 IS directly concered, Etherneto	C^* 150.0.0.0/21 is directly connected, Ethernett
K> 200.0.0.0/24 Via 150.0.0.1, Ethernetu	C^{*} 200.0.0/24 is directly innerted, defined 20
C>* 240.127.1.0/24 is directly connected, docker0	rotheic-29110/22 at allectry connected, dockero
root@sjc-z9100-01:~#	100CQSJC-25100-02.*#
🗖 2. sjc-z9100-01	G 3. sjc-z9100-02
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testuser@ubuntu-u3/:/tftpboot\$ ^ testuser@ubuntu-u37:/tftpboot\$	testuser@ubutu-u39:~\$ ^
testuser@ubuntu-u37:/tftpboot\$ ^ testuser@ubuntu-u37:/tftpboot\$ testuser@ubuntu-u37:/tftpboot\$	testuser@ubuntu-u39:~\$ ^ testuser@ubuntu-u39:~\$
testuser@ubuntu-u37:/tftpboot\$ testuser@ubuntu-u37:/tftpboot\$ testuser@ubuntu-u37:/tftpboot\$ testuser@ubuntu-u37:/tftpboot\$	testuser@ubuntu-u39:~\$ ^ testuser@ubuntu-u39:~\$ * testuser@ubuntu-u39:~\$ *
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<pre>testuser@ubuntu-u37:/fttpboct\$ testuser@ubuntu-u37:/fttpboct\$ testuser@ubuntu-u37:/fttpb</pre>	testuser@ubuntu-u39:-\$ testu

Fast-reboot in progress

Control plane goes for reboot with no disruption to data plane traffic (Window 1, 3)



Warm reboot in progress Data plane rebooted in 15s after control plane is up

root@sjc-z9100-01:~# docker ps		^	root@sjc-z9100-02:~#	^
CONTAINER ID IMAGE	COMMAND	CREATED	root@sjc-z9100-02:~#	
STATUS PORTS	NAMES		root@sjc-z9100-02:~#	
4c10ff43d626 docker-router-advertiser:lates	t "/usr/bin/supervisord"	About an	root@sjc-z9100-02:~#	
hour ago Up 16 seconds	radv		root@sjc-z9100-02:~#	
b2fbde1d2340 docker-dhcp-relay:latest	"/usr/bin/docker init"	About an		
hour ago Up 16 seconds	dhcp relay -			
860cb40a4230 docker-syncd-brcm:latest	"/usr/bin/supervisord"	About an		
hour ago Up 17 seconds	syncd			
a312e25711bf docker-orchagent-brcm:latest	"/usr/bin/supervisord"	About an	root@sjc-z9100-02:~#	
hour ago Up 20 seconds	swss		root@sjc-z9100-02:~# show ip route	
e6ec0089850e docker-teamd:latest	"/usr/bin/supervisord"	About an	Codes: K - kernel route, C - connected, S - static, R - RIP,	
hour ago . Un About a minute	teamd		O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,	
67158a28680f docker-platform-monitor:latest	"/usr/bin/supervisord"	About an	> - selected route, * - FIB route	
hour ago Un About a minute	nmon	mooute un		
0975546ec34c docker-lldn-sv2:latest	"/usr/bin/supervisord"	About an	B>* 10.1.0.1/32 [20/0] via 150.0.0.0, Ethernet0, src 10.1.0.2, 00:17:43	
hour ago Un About a minute	lldn	nooue un	C>* 10.1.0.2/32 is directly connected, to	
adfbd295d507 dockor_frm_guagga:latoct	"/ucr/bin/cuporwicord"	About an	K>* 100.0.0.0/24 via 150.0.0.0, Ethernet0	
acibuzoouogi uockei-ipm-quagga.iatest	han	About an	C>* 12/.0.0.0/8 is alrectly connected, 10	
nour ago op About a minute		7 h	C^* 130.0.0.0/24 is directly connected. Ethernet120	
01e442678216 docker-database latest	"/usr/bin/supervisora"	About an	C> 200.00.0724 is directly connected, docker0	
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FOOL@SJC-29100-01:~#	-	~		~
□ 2. sjc-z9100-01			🖾 3. sjc-z9100-02	
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Links & References

Command-Reference

https://github.com/Azure/sonic-utilities/blob/master/doc/Command-Reference.md

- Virtual Sonic setup
 https://github.com/Azure/sonic-mgmt/blob/master/ansible/doc/README.testbed.VsSetup.md
- Mailing List
 <u>sonicproject@googlegroups.com</u>
- Github
 <u>https://github.com/Azure/SONiC/</u>
- Wiki
 <u>https://github.com/Azure/SONiC/wiki</u>
- SAI
 <u>https://github.com/opencomputeproject/SAI</u>





SONIC at Comcast Datacenters

- Alankar Sharma alankar_sharma@comcast.com



- Vincent Celindro Network /R/evolutionist

