Open Hardware and Open Networking Software

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What is Open Networking?

- Open Networking includes:
  - Open Hardware (Switches)
    - Dell ON Series, HPE Altoline (Brite-Box)
    - Edge-Core, Quanta, Mellanox (White-Box)
  - Open Software (Network Operating System)
    - Microsoft Azure SONiC
    - Open Network Linux + Network API (SAI, OpenNSL)
    - OpenSwitch (OPX)
"By 2020, we expect 22% of data center Ethernet switches to be either white-box or brite-box switches, with disaggregated hardware-software stack" -- Gartner Research (Jan 2017)
Why Open Networking from 2013+?

- There has always been some level of open networking on the public Internet (e.g. Zebra)
- This talk focuses on when open networking hardware and software became mainstream and easy to use i.e. around the release of ONIE
The Importance of ONIE in Open Networking
Before ONIE – A Few Hurdles

- Open switch and remove CF/SD Card
- Make image of CF/SD Card
- Put CF/SD Card back in switch
- Boot switch into diagnostic mode
- Mount CF/SD Card
- Copy/Uncompress image on to CF/SD Card
- Set bootloader arguments
  - set cfcard_bootcmd2 'setenv bootargs root=/dev/hda1 rw noinitrd console=ttyS0,$baudrate; ext2load ide 0:1 0x1000000 boot/limage;ext2load ide 0:1 0x400000 boot/LB9A.dtb;bootm 1000000 – 400000'
  - set bootcmd 'run cfcard_bootcmd2'
- Save and reset to enjoy new image
After ONIE

• Install ONIE via USB (if not already installed)
• Boot switch and choose from
  – ONIE: Install OS
  – ONIE: Rescue (drop to shell)
  – ONIE: Uninstall OS
  – ONIE: Update ONIE
• Done
Open Networking Hardware
Types of Open Networking Hardware

- **White-Box**
  - Generic switches with hardware support
  - Generally come with ONIE and no NOS

- **Brite-Box**
  - Branded, supported switches sold by big name vendors such as Dell and HPE
  - Generally come with vendors NOS but can run other networking operating systems
  - Note: Many Brite-Box switches are re-branded White-Box switches
What Makes Hardware Open?

- Open can stand for several things from the ability to install a different NOS to making full design packages available to the public.

- The best representation comes from the Open Compute Project Networking Group.
  - Founded in 2013.
  - Hardware Design contributors include: Edge-Core, Quanta, Facebook, Mellanox and others.
  - All submitted designs are open and include the necessary data to construct the network device.
Main PCB Block Diagram

CPU P2041
(Module)

CPLD1

CPU C2538
(Module)

Power Supply (400W)

SC243

SL9567\R6

CHL9203

IR3550

CPU

PCIe

SGML

BCM54616S

Management port

Console port

MDI

USB

USB port

BCM56854

48x10G SFP+
(Port 1~48)

6x40G QSFP+
(Port 49~54)

CPLD2.3

SFI

XCPE

1X/aut, 1X/Dis, RX/Loss, Mode

Edge-Core AS5712-54X Specs
Open Networking Software
What Makes Networking Software Open?

• Open Source Network Operating Systems
  – Generally based on Debian Linux (OPX, SONiC, ONL, etc.)
  – Provide hardware and network abstraction
  – Use Open Source networking stacks such as FRR or BIRD
  – Most all have some non-open dependencies such as forwarding ASIC API/SDK for network abstraction
    • Note: SAI is the first cross platform open source switch abstraction
Anatomy of an Open Source NOS

- **OpenFlow Controller**
- **Indigo OpenFlow Agent**
  - **SensorD**
  - **ONLPD**
  - **SNMP**
  - **Indigo OF-DPA Driver**
  - **ONL Platform APIs**
  - **ONL Distribution (Linux + stuff)**

**Applications**
- **OF-DPA Driver**
- **BRCM SDK**

**Platform**
- **Open Source**
- **Closed Source**
- **Debian Linux**
- **Hardware**
  - **CPU** (x86, PPC)
  - **Misc Hardware** (fans, LEDs, SFP, sensors)
  - **BRCM**
Most chip vendors only allow binary versions of their switch abstraction interfaces. But with SAI and P4 we are seeing changes:

**Broadcom**
- OpenNSL (Closed Source, Open API)
- OF-DPA (Closed Source, OpenFlow vX compatible)
- SAI (Closed Source, SAI vX compatible)
- P4 Runtime (Closed Source, P4 vX compatible)
- SDKLT (Announced Open Source SDK) <- Yay!

**Others:**
- Cavium OpenXPS (Open Source, SAI compatible)
SAI – Building an Open ASIC Abstraction

**Organizations**

- March 16
- March 17
- March 18

**Commits**

- March 16
- March 17
- March 18

**Proposals**

- March 16
- March 17
- March 18

**Timeline**

- Mar 16
  - V0.9.4
- Aug 16
  - V0.9.5
- Dec 16
  - SAI 1.0
- Apr 17
  - V1.1
- Oct 17
  - V1.2
- Mar 18
  - SAI 1.3

**Dates**

- 1/1/2016
- 1/1/2017
- 1/1/2018
- 4/30/2018

**Versions**

- V0.9.4
- V0.9.5
- V1.0
- V1.1
- V1.2
- SAI 1.0
- SAI 1.3
Linux Foundation Networking Subprojects

- **OpenSwitch (OPX)**
  - Dell OS10 Open Edition (Debian + CPS) + Quagga/FRR focused on Dell Open Networking switches

- **CoRD**
  - ONOS Controller with Indigo agent on switches

- **FRR**
  - Routing suite used by most open networking software
Open Compute Networking Subprojects

- **ONIE** – Open Network Install Environment
  - Tiny Linux environment that allows for installation/removal/debugging of NOS
- **Open Networking Linux (ONL)**
  - Switch OS with platform support (ONLP)
- **SAI** - Switch Abstraction Interface
  - Cross Platform Switch API
- **SONiC**
  - Microsoft / Azure NOS used by Alibaba, Tencent and many others
OPX and SONiC

- Platform Support
  - SONiC Supports more vendors
    • Edge-Core, Dell, Mellanox, etc
    • 33 devices currently
  - OPX Supports most Dell ON platforms
    • 13 Dell ON devices, 1 Edge-Core device

- L3
  - Using Quagga moving to FRR

- L2
  - Both support VLANs, LLDP. OPX supports STP, RSTP, PVST, MSTP

- OPX has significant documentation due to using OS10 Open Edition.
ONL Spreading Across Many Platforms

- **NTT NOS Project**: Specialized Routing Agent
- **Hyper-scaler NOS stack**: Leverage ONL + SONiC on Edge-Core Cassini with NTT Electronics DSPs.
- **Telco Central Office Stack**: Rapidly leverage open hardware ecosystem with modular NOS approach
- **Open-source NG-SDN switching platform**: Leverage white-box ecosystem with ONL platform software for open leaf-spine fabric for central offices
- **BSN’s Commercial SDN Fabric Solutions**: Leveraging ONL as part of open reference platform for “software-defined” data plane
- **Big Monitoring Fabric**
- **Big Cloud Fabric**

ONL Currently Supports 71 Different Network Devices
Future of Open Networking?

- Large vendors recognize importance of OS NOS (e.g. Cisco IOS-XR w/ ONLP)
- Increased customer requirement for Open Source NOS driving adoption (e.g. SONiC)
- SAI included as default in most Open Source NOS
- Expansion of ONL platform ecosystem (currently 71 systems)
- P4 gains more traction
Questions?

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