Open Networking Hardware and Software

Steven Noble / Big Switch Networks

@sonoble
What is Open Networking?

- **Open Networking includes:**
  - **Open Networking Hardware (Switches)**
    - Dell ON Series, HPE Altoline (Brite-Box)
    - Edge-Core, Quanta, Mellanox (White-Box)
  - **Open Networking Software (NOS)**
    - Microsoft Azure SONiC
    - Open Network Linux + Network API (SAI, OpenNSL)
      - Supports FBOSS, Arrcus, Stratum, etc
    - 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 and ONL
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/uImage;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
The Importance of ONL in Open Networking
ONL

- The first fully open source network operating system with support for hardware switches
- Supports a diverse set of platforms (e.g. Edge-Core, Dell, HPE) and chip vendors (e.g. Broadcom, Barefoot, Mellanox)
- Used in many projects such as Stratum and CoRD
- Accelerates commercial NOS development: Big Switch, SnapRoute, Arrcus
ONL Certified Program

- A no cost certification program for switch vendors who have ported their devices to ONL
- Provides multiple options including a Gold level where the switches are tested on a routine basis
- All testing is automatic and uses real hardware
- Current Gold members: DNI, Edge-Core, HPE and Quanta
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
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

Applications
- FRR

Platform
- ONL Platform APIs
- ONL Distribution (Linux + stuff)
- SDK API
- SDK

Hardware
- CPU (x86, PPC)
- Misc Hardware (fans, LEDs, SFP, sensors)
- BRCM
Most chip vendors only allow binary versions of their switch abstraction interfaces with a documented open API. But with SAI we are seeing changes:

**Broadcom**
- OpenNSL (Open API)
- OF-DPA (Open API)
- SAI (Open API)
- SDKLT (Open Source)

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

Organizations

Commits

Proposals

0
100
200
300
400
500
600
700
800
March 16  March 17  March 18

0
10
20
30
40
50
60
March 16  March 17  March 18

March 16  March 17  March 18

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

1/1/2016  1/1/2017  1/1/2018  4/30/2018
Linux Foundation Networking Subprojects

- OpenSwitch (OPX)
  - Debian + Dell Control Plane Services (CPS) + Quagga/FRR
- CoRD
  - ONOS Controller with Indigo agent on switches
- FRR
  - Routing suite used by most open networking software
- Stratum
  - P4 based NOS contributed by Google to the ONF
Open Compute Networking (OCP) 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)
  - Used by Arrcus, Snaproute, IOS-XR

- **SAI - Switch Abstraction Interface**
  - Cross Platform Switch API

- **SONiC**
  - Microsoft / Azure NOS used by Alibaba, Tencent and many others
OPX, ONL and SONiC

- **Platform Support**
  - SONiC Supports 33 devices
  - OPX Supports 14 devices
  - ONL Supports 71 devices

- **L3**
  - Using Quagga moving to FRR

- **L2**
  - Basic L2 Support: VLANS, LLDP
ONL Spreading Across Many Platforms

- **NOS Project**: Specialized Routing Agent
  Leverage ONL + SONiC on Edge-Core Cassini with NTT Electronics DSPs.

- **Hyperscaler NOS Stack**: Rapidly leverage open hardware ecosystem with modular NOS approach

- **Telco Central Office Stack**: Leverage white-box ecosystem with ONL platform software for open leaf-spine fabric for central offices

- **Open-source NG-SDN switching platform**: Leveraging ONL as part of open reference platform for “software-defined” data plane

- **BSN’s Commercial SDN Fabric Solutions**: Hardened ONL versions for supported open networking hardware

Leveraged By: Arrcus, Snaproute and IOS-XR
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 (ONL, FRR, SONiC, etc)
- SAI included as default in most Open Source NOS
- Expansion of ONL platform ecosystem (currently 71 systems)
- Emergence of P4, NPL and other network programming languages.
Questions?

snoble@bigswitch.com