Open Network Install Environment (ONIE) LinuxCon North America 2015

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Agenda

- What is It?
- ONIE Solves a Real Problem
- ONIE Design Approach
- ONIE Adoption
- ONIE Technical Deep Dive

ONIE - Open Network Install Environment

Modern, Efficient OS Installer

- Network OS Installer
- Improve Loading Dock to Rack Experience

ONIE - Open Network Install Environment

Industry Support

- Sub-project with the Open Compute Project
- Enables open network hardware ecosystem
- Community Supported

OPEN
Compute Project

ONIE

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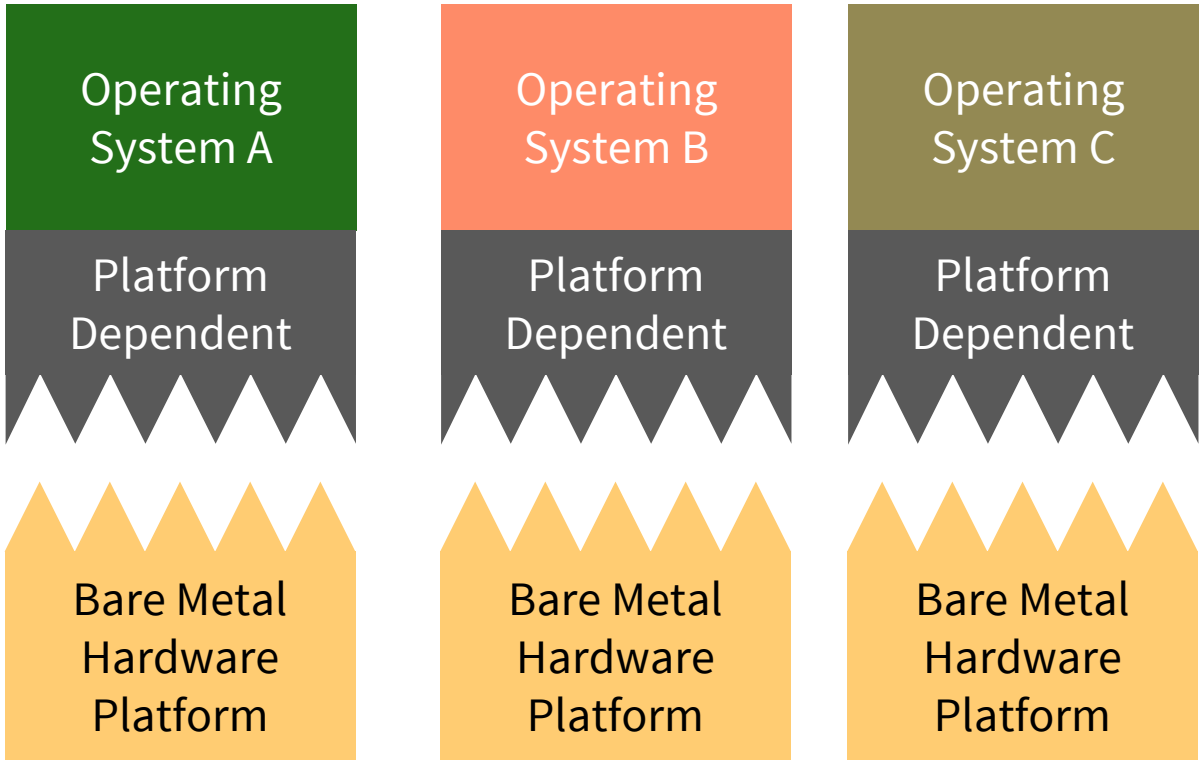
Confluence of Difficulties

- Each hardware platform is unique
- Data center operators want to automate provisioning
- End users want choice of HW and SW
- Similar to server industry moving from various hardware platforms (SUN, SGI, x86)
- PXE was OK, but could be much more modern, geared towards automation

Create an Ecosystem for Bare Metal Switches

Before ONIE
The Appliance Model

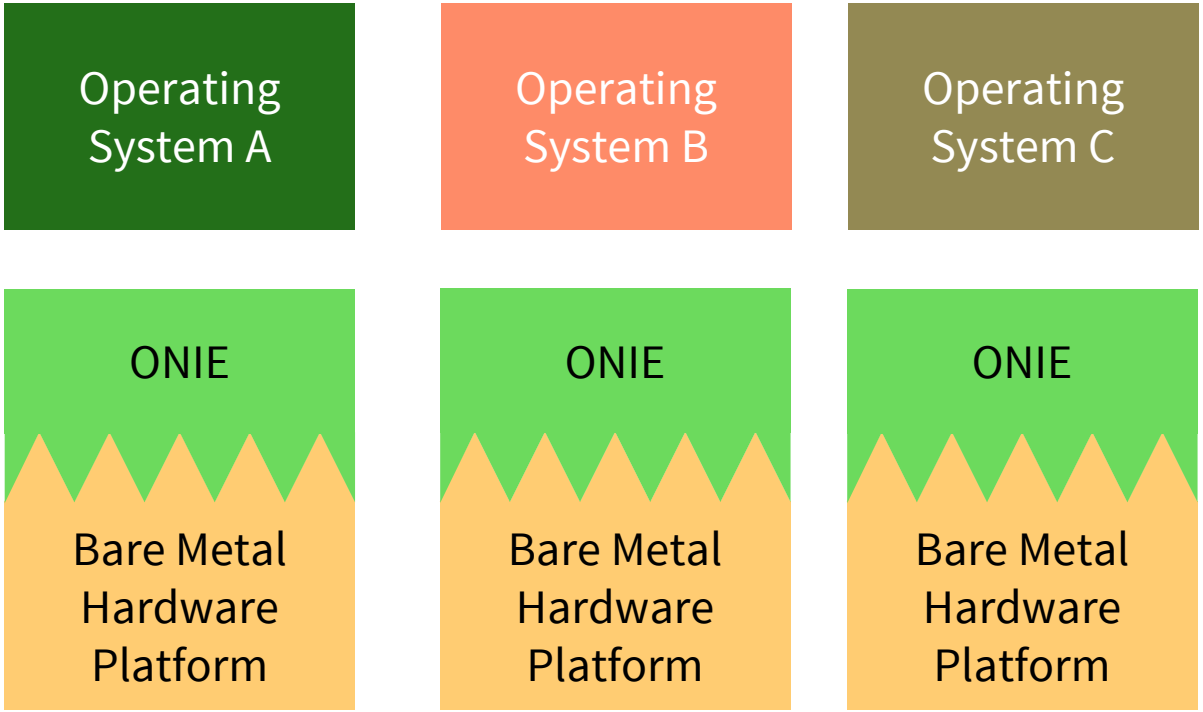
- OS Vendors wrote their own platform dependent OS installer and integration layer
- Hardware Vendors maintained separate SKUs for each combination of OS and platform
- End Users could not change the OS, it was an appliance



Create an Ecosystem for Bare Metal Switches Cont.

ONIE Smooths out the Rough Edges

- Hardware Vendors maintain a single ONIE SKU for each hardware platform. Opens up the distribution channels
- OS Vendors target a common installer format. Speeds time to market
- End Users can pick and choose among a variety of Operating Systems. Automated mega-scale OS and hardware provisioning is now possible



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A New Approach

- More modern than PXE
- Pre-installed on the switch by the hardware vendor
- A small operating system based on Linux and Busybox
- Could have enhanced BIOS or U-Boot, but Linux is way more capable: device drivers, networking, applications
- Support IPv6, HTTP/S, DHCP and existing TFTP infra
- Designed for Automation
- Additional meta-data during network installs

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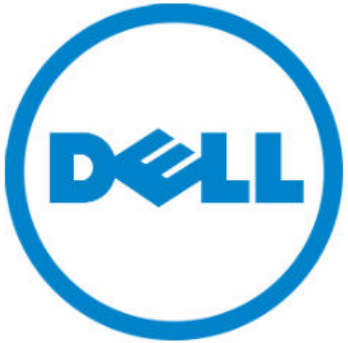
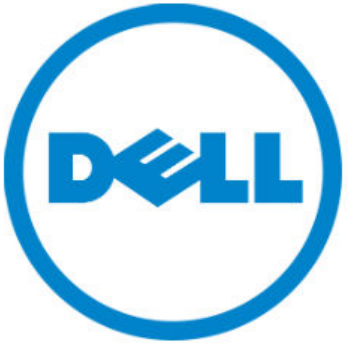
Time line

- Late 2012, brainstormed initial features
- Early 2013, evangelized with HW vendors
- May 2013, first public demo at OCP MIT Workshop
- Summer 2013, first products available from multiple vendors
- Summer 2013, project incubated by OCP
- June 2014, project fully adopted by OCPP
- August 2015, 40+ HW platforms and 12+ HW vendors

Hardware Vendors



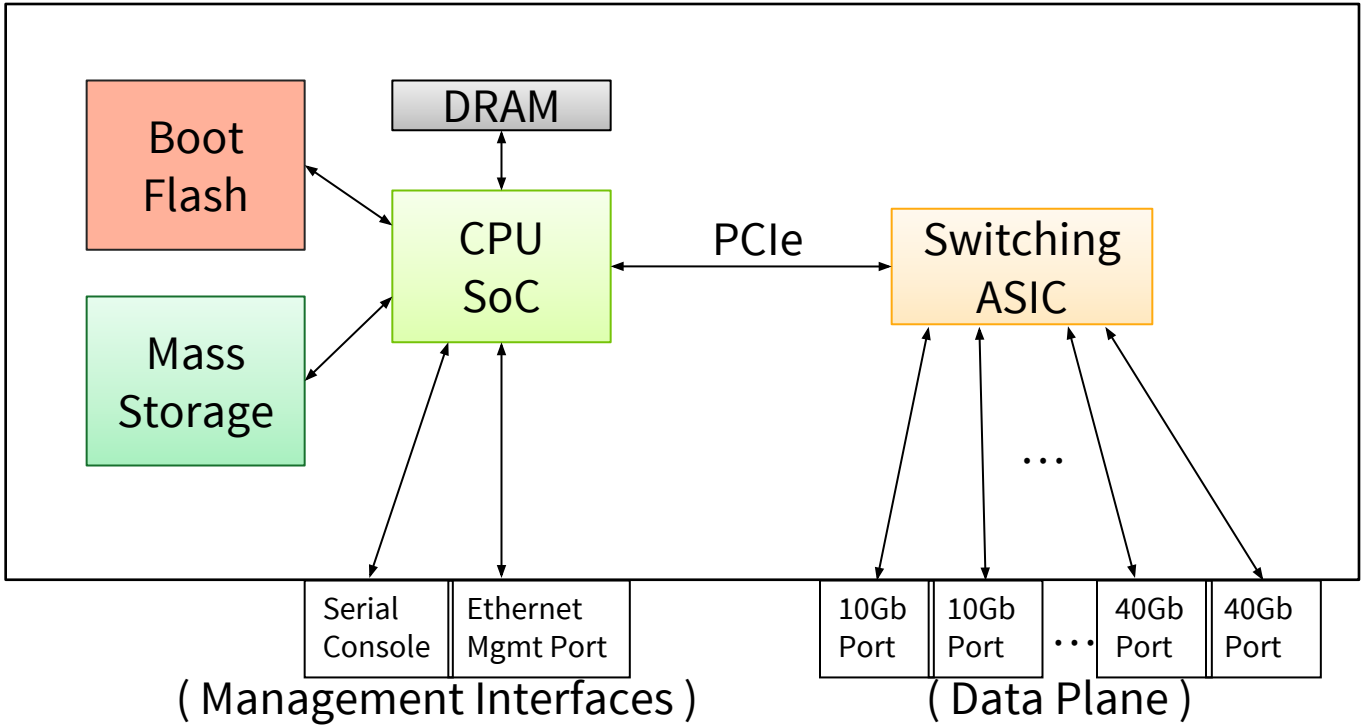
Operating System Vendors



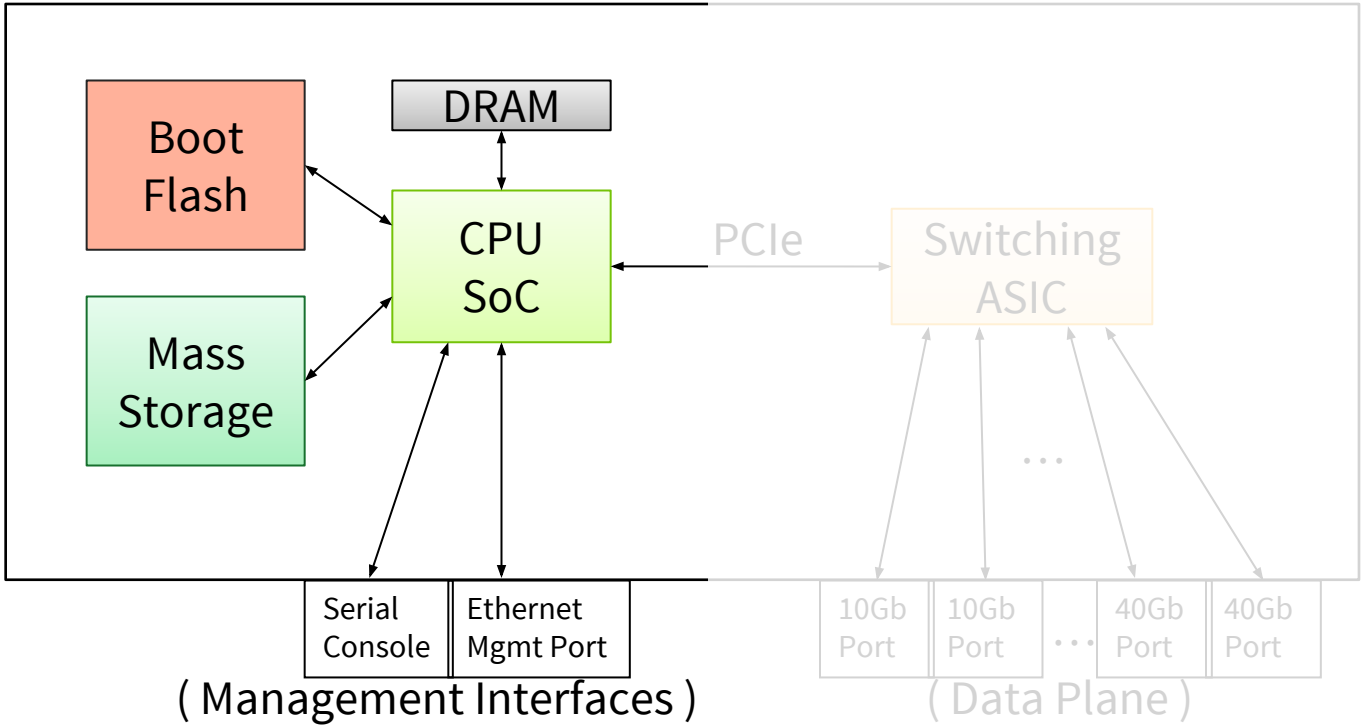
How Does ONIE Work?

- Leverages the Linux kernel and BusyBox
- A few state machines to manage network interfaces and image discovery methods
- Shell scripting is the programming language

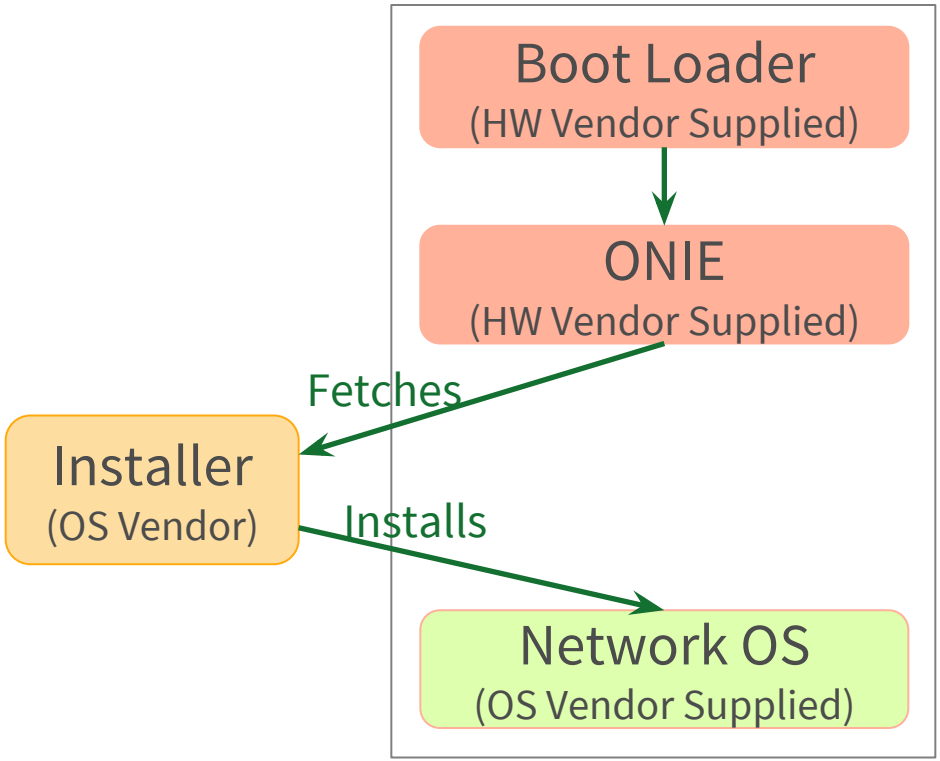
Anatomy of a Network Switch



Management Interfaces



Bare Metal Install - First Time Boot Up



Boot Loader

- Low Level boot loader, configures CPU complex
- Loads and boots ONIE

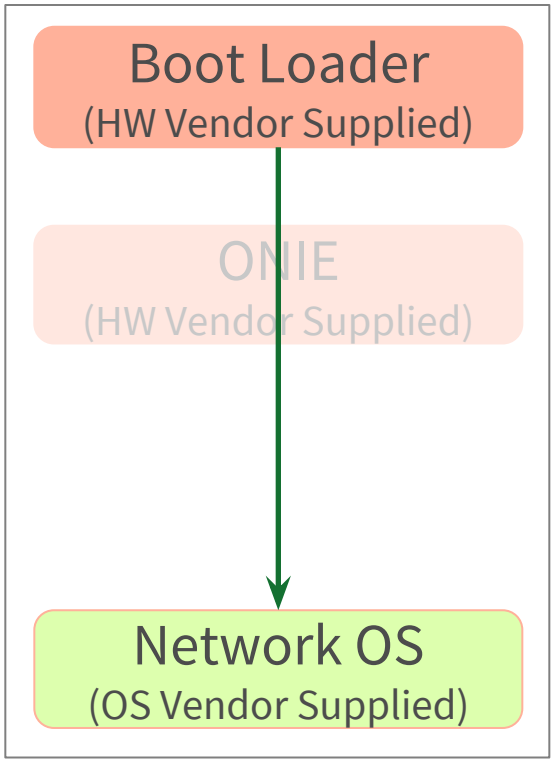
ONIE

- Linux Kernel with Busybox
- Configures management Ethernet interface
- Locates and executes an OS installer
- Provides tools and environment for installer

OS Installer

- Available from network or USB
- Linux executable
- Installs vendor OS into mass storage

Subsequent Reboots - OS is Already Installed



Boot Loader

- Low Level boot loader, configures CPU complex
- Loads and boots OS vendor's installed OS

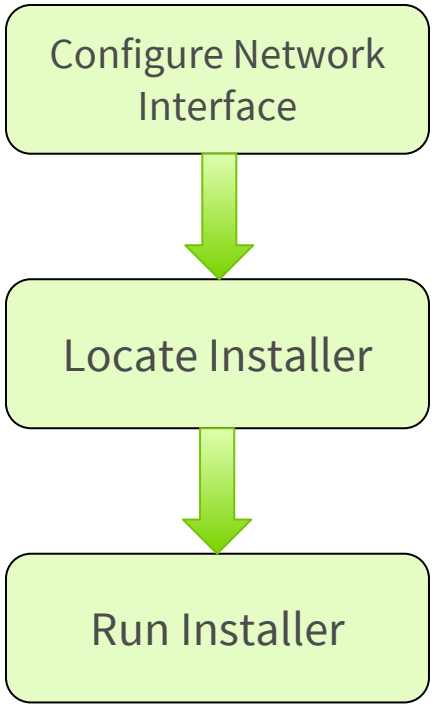
ONIE

- Still exists, but is not used
- Available for uninstall / re-install operations

Network OS

- Configures Switching ASIC
- Runs Network Protocols
- Provides CLI

Network OS Installer Discovery and Install Behavior



- Uses DHCPv4, DHCPv6
- Configures Ethernet interface for IPv4 / IPv6
- Configures DNS and hostname

- Determines the location of an installer executable
- Examines local file systems, e.g. USB flash drives
- Uses DHCP options and IPv6 Neighbors

- Downloads installer via URL
- Launches installer

Installer Discovery Waterfalls

1 Management interface

- IPv6 network discovery
- DHCPv4
- Static IP address

2 OS installation source

- Local USB
- HTTP
- FTP
- TFTP

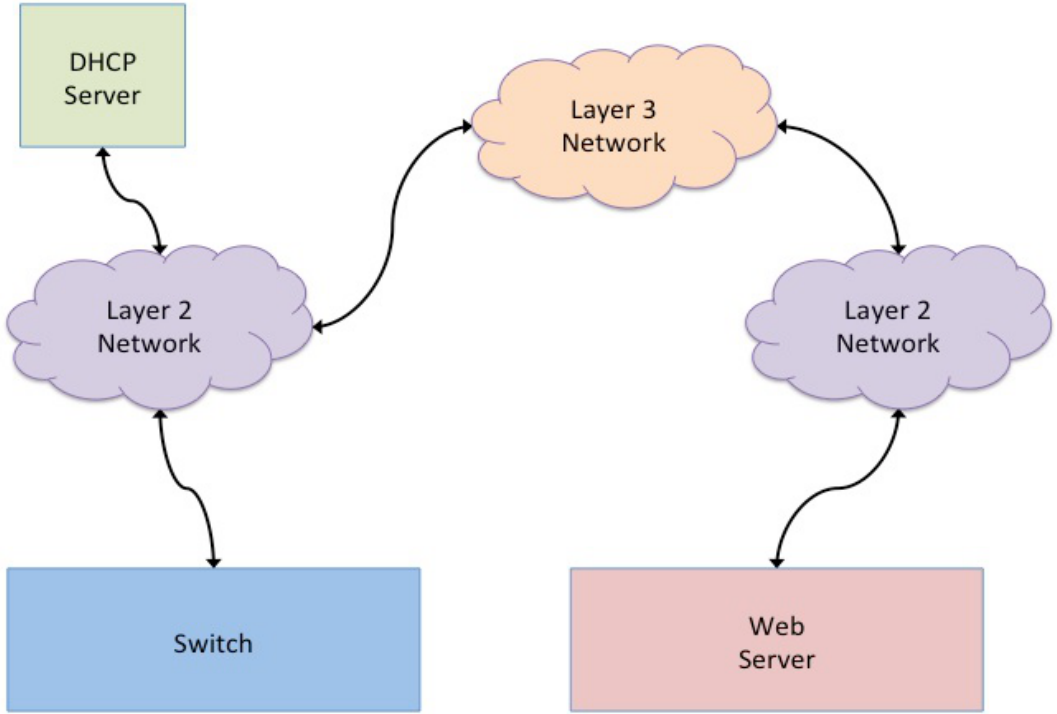
3 File name search

- `onie-installer-<arch>`
- `onie-installer-<vendor>`
- `onie-installer`

Example: DHCP Configuration

Situation:

- OS Installer resides on HTTP server
- HTTP server is on a different sub-net from the target
- DHCP Server provides router and installer URL info
- ONIE discovers parameters and installs OS



Example: DHCP Configuration Cont.

```
subnet 203.0.113.0 netmask 255.255.255.0 {
  range 203.0.113.20 203.0.113.200;
  option domain-name-servers 203.0.113.2;
  option routers 203.0.113.3;
  option default-url = "http://img-server/installer";
}
```

Fallback Image Location Methods

When All Else Fails Try ….

- Well known file names on link local neighbors using IPv4, IPv6, HTTP and TFTP
- Classical TFTP MAC address based PXE waterfall

Installer Mode GRUB Menu

Booting into Installer Mode

```
ONIE: OS Install Mode ...
Version     : 2015.08
Build Date: 2015-07-19T09:57-0700
Info: Mounting kernel filesystems... done.
Info: Mounting LABEL=ONIE-BOOT on /mnt/onie-boot ...
Info: Using eth0 MAC address: 44:38:39:00:68:00
Info: eth0:  Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 10.42.0.32 / 255.255.252.0
Starting: dropbear ssh daemon... done.
Starting: telnetd... done.
discover: installer mode detected.  Running installer.
Starting: discover... done.

Info: eth0:  Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 10.42.0.32 / 255.255.252.0
ONIE: Starting ONIE Service Discovery
```

IPv4 / IPv6 HTTP and TFTP Waterfall

```
Info: Fetching http://10.0.1.251/onie-installer-x86_64-dell_s6000_s1220-r0 ...
Info: Fetching http://10.0.1.251/onie-installer-x86_64-dell_s6000_s1220 ...
Info: Fetching http://10.0.1.251/onie-installer-dell_s6000_s1220 ...
Info: Fetching http://10.0.1.251/onie-installer-x86_64 ...
Info: Fetching http://10.0.1.251/onie-installer ...
Info: Fetching http://fe80::206:67ff:fe24:679b0.000000e+00th0/onie-installer-x86_64-dell_s6000_s1220-r0 ...
Info: Fetching http://fe80::206:67ff:fe24:679b0.000000e+00th0/onie-installer-x86_64-dell_s6000_s1220 ...
Info: Fetching http://fe80::206:67ff:fe24:679b0.000000e+00th0/onie-installer-dell_s6000_s1220 ...
Info: Fetching http://fe80::206:67ff:fe24:679b0.000000e+00th0/onie-installer-x86_64 ...
Info: Fetching http://fe80::206:67ff:fe24:679b0.000000e+00th0/onie-installer ...
Info: Fetching tftp://10.0.1.251/44-38-39-00-68-00/onie-installer-x86_64-dell_s6000_s1220-r0 ...
Info: Fetching tftp://10.0.1.251/0A2A0020/onie-installer-x86_64-dell_s6000_s1220-r0 ...
Info: Fetching tftp://10.0.1.251/0A2A002/onie-installer-x86_64-dell_s6000_s1220-r0 ...
Info: Fetching tftp://10.0.1.251/0A2A00/onie-installer-x86_64-dell_s6000_s1220-r0 ...
Info: Fetching tftp://10.0.1.251/0A2A0/onie-installer-x86_64-dell_s6000_s1220-r0 ...
Info: Fetching tftp://10.0.1.251/0A2A/onie-installer-x86_64-dell_s6000_s1220-r0 ...
Info: Fetching tftp://10.0.1.251/0A2/onie-installer-x86_64-dell_s6000_s1220-r0 ...
```

Image Request HTTP Headers

```
GET /onie-installer HTTP/1.1
Host: 192.168.1.240
User-Agent: onie/1.0 (Linux-4.1.3-onie+2015.08; BusyBox-v1.20.0)
Connection: close
ONIE-SERIAL-NUMBER:
ONIE-ETH-ADDR: 44:38:39:00:68:00
ONIE-VENDOR-ID: 674
ONIE-MACHINE: dell_s6000_s1220
ONIE-MACHINE-REV: 0
ONIE-ARCH: x86_64
ONIE-SECURITY-KEY:
ONIE-OPERATION: os-install
ONIE-VERSION: 2015.08
```

Additional Operations

Reinstall	Return to “out of the box” initial provisioning state
Uninstall	Completely wipe out everything, except ONIE
Rescue	Reboot into ONIE for repair, debug and forensics
Update	Install a new ONIE version or other firmware
Diag	Run HW vendor’s diagnostics

Support Multiple CPU Architectures

- PowerPC – Ready Today
- x86 – Ready Today with virtual machine
- ARMv7 – Ready Today
- Planning for MIPS
- Maintain ONIE behaviors across architectures

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ONIE Websites

- Home Page: www.onie.org
- Source Code: github.com/opencomputeproject/onie
- Documentation: github.com/opencomputeproject/onie/wiki
- Mailing List: lists.opencompute.org/mailman/listinfo/opencompute-onie
- OCP Wiki: www.opencompute.org/wiki/Networking/ONIE
- Blogs: cumulusnetworks.com/blog
- Twitter: @ProjectONIE @curtbrune

Thank You!