Open Network Install Environment

Curt Brune
Member of Technical Staff
January 2014
Overview

What Is ONIE?
Lessons Learned
ONIE Development
Demo
Project Directions
What Is ONIE?

Network OS Install Environment

- Provides an environment for network OS installer discovery and execution
- Like a pre-installed kickstarter
- Defined by its behaviors
- Implemented using a modern Linux kernel and BusyBox

An Open Source Project within OCP


Evolving ...
Hardware Vendors

- Agema
- Dell
- Edge-Core Networks
- Penguin Computing
- Interface Masters
- Mellanox Technologies
- Broadcom
- Quanta
ONIE: Anatomy of a Network Switch

- **Boot Flash**
- **Mass Storage**
- **CPU SoC**
- **DRAM**
- **Switching ASIC**

**Management Interfaces**
- Serial Console
- Ethernet Mgmt Port

**Data Plane**
- 10Gb Port
- 10Gb Port
- 40Gb Port
- 40Gb Port

**PCle**
ONIE: Uses Management Interfaces

- Boot Flash
- Mass Storage
- CPU SoC
- DRAM

Management Interfaces:
- Serial Console
- Ethernet Mgmt Port

Data Plane:
- PCIe
- Switching ASIC
- 10Gb Port
- 40Gb Port

( Management Interfaces )
( Data Plane )
ONIE: 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

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

Network OS
- Configures management Ethernet interface
- Locates and executes an OS installer
- Provides tools and environment for installer

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
ONIE: Subsequent Reboots – Vendor’s 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
ONIE: Network OS Installer Discovery and Install Behavior

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

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

- Run Installer
  - Downloads installer via URL
  - Passes various environment variables to installer
  - Launches installer
Why Not Use PXE?

- IPv6 and HTTP out of the box
- Use existing Linux device drivers. No need to write new ones
- Integrated automation
## ONIE: Other Behaviors

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinstall</td>
<td>Remove currently installed OS and return to the “out of box” provisioning state</td>
</tr>
<tr>
<td>Uninstall</td>
<td>Completely wipe out everything, except ONIE</td>
</tr>
<tr>
<td>Rescue</td>
<td>Reboot box into ONIE for repair, debug and forensics</td>
</tr>
<tr>
<td>Update</td>
<td>Install a new ONIE version</td>
</tr>
<tr>
<td>Diag</td>
<td>Run HW Vendor’s diag (optional)</td>
</tr>
</tbody>
</table>

Provides a mechanism for a network OS to invoke the above behaviors.
Lessons Learned

Hardware Platforms

- Diverse mix of CPU complex designs, even within a single CPU family.
- HW Vendors need freedom to customize ONIE
- Need mechanism to run HW vendor diag

Recurring Themes

- TLV based EEPROM format widely adopted
- Common HW designs reduce development time
Support Multiple CPU Architectures

- PowerPC – Today
- x86 – VM Prototype available today
- Thinking about ARM, MIPS
- Maintain ONIE behaviors across architectures

Testing and Compliance

- Enhance and extend regression test suites
- Develop compliance test suites
ONIE Ongoing Development

New Features

- DHCPv6
- DNS Service Discovery / Multicast DNS discovery
- HW Vendor diagnostic

Releases

- Quarterly release cadence
- Ongoing maintenance
- Enhancements
ONIE x86 Strategy

- Use existing BIOS from hardware vendors
- During manufacturing install GRUB2 and ONIE-x86 on the mass storage block device
- NOS Installer adds partitions, installs software and updates GRUB2 configuration.
### Block Device Partitioning

- **Partition using** [GUID Partition Table](#) (GPT) format
- **GPT supported by** Linux, GRUB, UEFI
- **Supports dual-booting multiple operating systems**

<table>
<thead>
<tr>
<th>Partition #</th>
<th>Name</th>
<th>R/W</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GRUB Boot</td>
<td>r/o</td>
<td>Used by GRUB and GPT</td>
</tr>
<tr>
<td>2</td>
<td>ONIE BOOT</td>
<td>r/o</td>
<td>ONIE Kernel</td>
</tr>
<tr>
<td>3</td>
<td>ONIE CONFIG</td>
<td>r/w</td>
<td>Configuration</td>
</tr>
<tr>
<td>4+</td>
<td></td>
<td></td>
<td>For NOS use</td>
</tr>
</tbody>
</table>
GNU GRUB version 2.00

ONIE: Install OS
ONIE: Rescue
ONIE: Uninstall OS
ONIE: Update ONIE

Use the ^ and v keys to select which entry is highlighted. Press enter to boot the selected OS, 'e' to edit the commands before booting or 'c' for a command-line. ESC to return previous menu.
NOS Installer Duties

- Create new GPT partition(s)
- Create file systems on partition(s)
- Install NOS files into partition(s)
- Update ONIE-CONFIG using ONIE provided CLIs
  - `onie-boot-entry-add`
  - `onie-boot-entry-remove`
  - `onie-boot-entry-show`
  - `onie-boot-default`
  - `onie-boot-update`
- Interface Masters Box with ONIE
- HTTP based install
- DHCP server configuration
- Install the ONIE Demo OS
- Go back and Install Cumulus Linux
ONIE Project Directions

Administrative

- Update ONIE draft specification with community
- Improve documentation
- Meeting cadence, e.g. monthly phone conference
- Area specialists, contributors, testers
ONIE Websites

- Main Page: http://www.onie.org/
- Source Code: https://github.com/onie/onie/
- Documentation: http://onie.github.io/onie/
Thank You!
ONIE Boot Partition

- Read-Only, except when updating ONIE itself
- Contains default GRUB config file
- Contains ONIE kernel and initramfs
ONIE Config Partition

- Read-Write
- Contains GRUB configuration files
- The NOS installer updates the GRUB configuration by changing files in this partition
Booting

- BIOS loads GRUB from block device Master Boot Record
- GRUB checks the following:

```c
if exists ONIE-CONFIG/grub.cfg {
    load ONIE-CONFIG/grub.cfg
} else {
    load ONIE-BOOT/grub-default.cfg
}
```

On a fresh install grub-default.cfg boots ONIE in the installer mode. Otherwise load the grub.cfg a NOS installer has setup.