Open Source Firmware @ Facebook

"if you don't own your firmware, your firmware owns you"

David Hendricks: Firmware Engineer
Andrea Barberio: Production Engineer

Open Source @ Facebook

- Facebook promotes open source

  - Systems Software: Kernel, CentOS, chef, etc.

  - Hardware: Open Compute Project, Telecom Infrastructure Project

  - Lots more: https://github.com/facebook and https://github.com/facebookincubator

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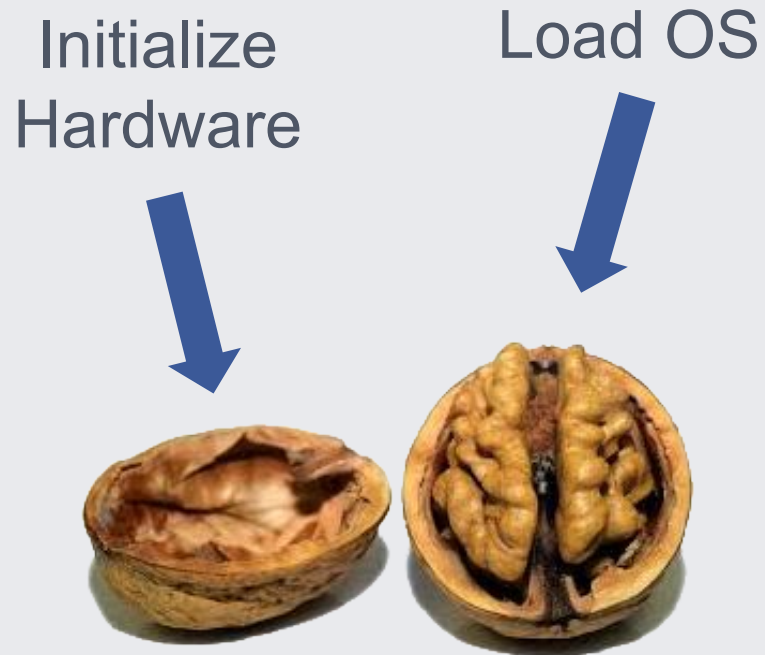OpenBMC initially released in 2015 and is quickly becoming standard on OCP hardware
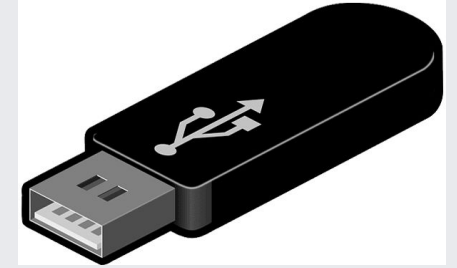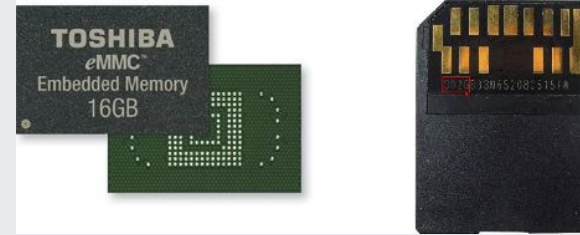

System firmware is the next logical step

System firmware in a nutshell

- First bit of code that runs when CPU is turned on

- Sometimes referred to as "BIOS"

Initialize Hardware

Load OS

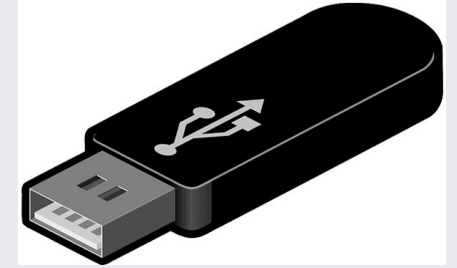# Problem: Local booting is more complex
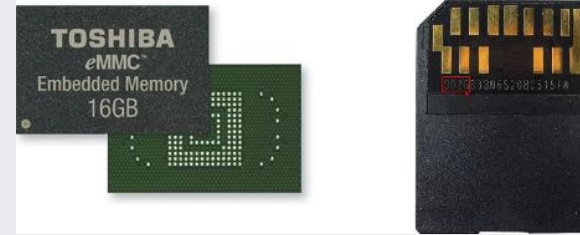

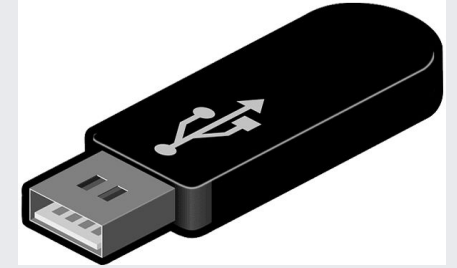| Then	Now
Few, simple interfaces	Many interfaces and protocols

Problem: Local booting is more complex

Then	Now
Few, simple interfaces	Many interfaces and protocols
Simple, low-speed links	High-speed links

Problem: Local booting is more complex
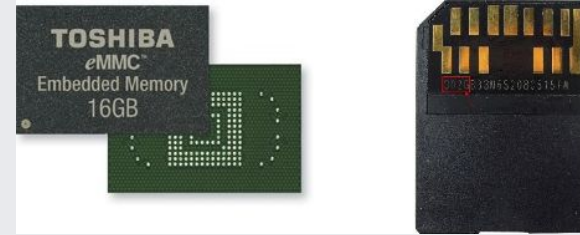
Then	Now
Few, simple interfaces	Many interfaces and protocols
Simple, low-speed links	High-speed links
Blindly execute MBR (CHS 0/0/1)	Decrypt & mount filesystem

Problem: Network booting is more complex

Then	Now
Small, trusted networks	Global, untrusted networks

Problem: Network booting is more complex

Then	Now
Small, trusted networks	Global, untrusted networks
Few, simple interfaces and protocols	Many interfaces and protocols

Problem: Network booting is more complex

Then	Now
Small, trusted networks	Global, untrusted networks
Few, simple interfaces and protocols	Many interfaces and protocols
TFTP/PXE, security an afterthought	TLS/HTTPS, designed for security

TL;DR: SysFW is complex

Then/Now	Now/Future
SysFW/BIOS is an OS	Let Linux Do It

The Solution: Let Linux Do It

Then/Now	Now/Future
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Opaque	Open, well-understood at FB

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LinuxBoot

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Proprietary ecosystem	Auditable, debuggable

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Vendor-specific tooling	Open-source tools

The Solution: Let Linux Do It

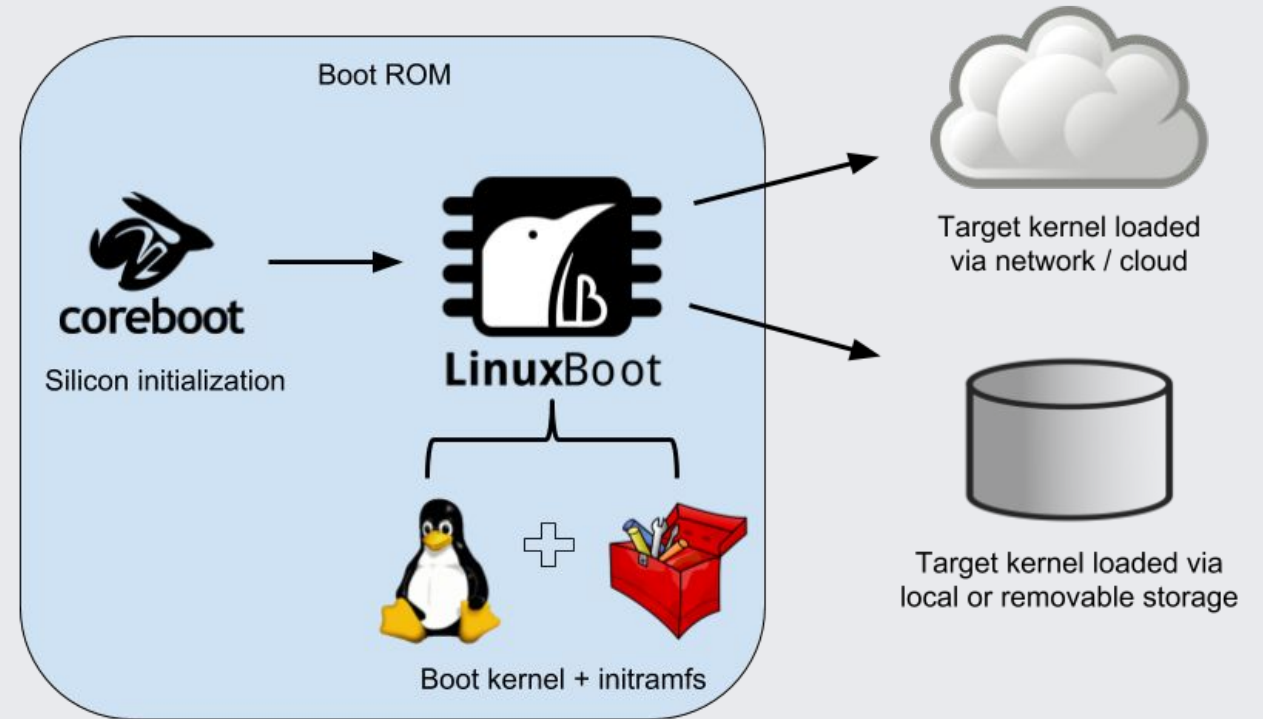| Then/Now	Now/Future
SysFW/BIOS is an OS	Let Linux Do It
Opaque	Open, well-understood at FB
Proprietary ecosystem	Auditable, debuggable
Vendor-specific tooling	Open-source tools
Product-specific	Portable, re-usable

Let Linux Do it

- **Put a kernel+initramfs in boot ROM**
- **Do minimal silicon init and jump to Linux as soon as possible**
- **Use Linux to boot Linux**

Let Linux Do it

- Put a kernel+initramfs in boot ROM
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- Use Linux to boot Linux
- **Production-quality drivers, networking**

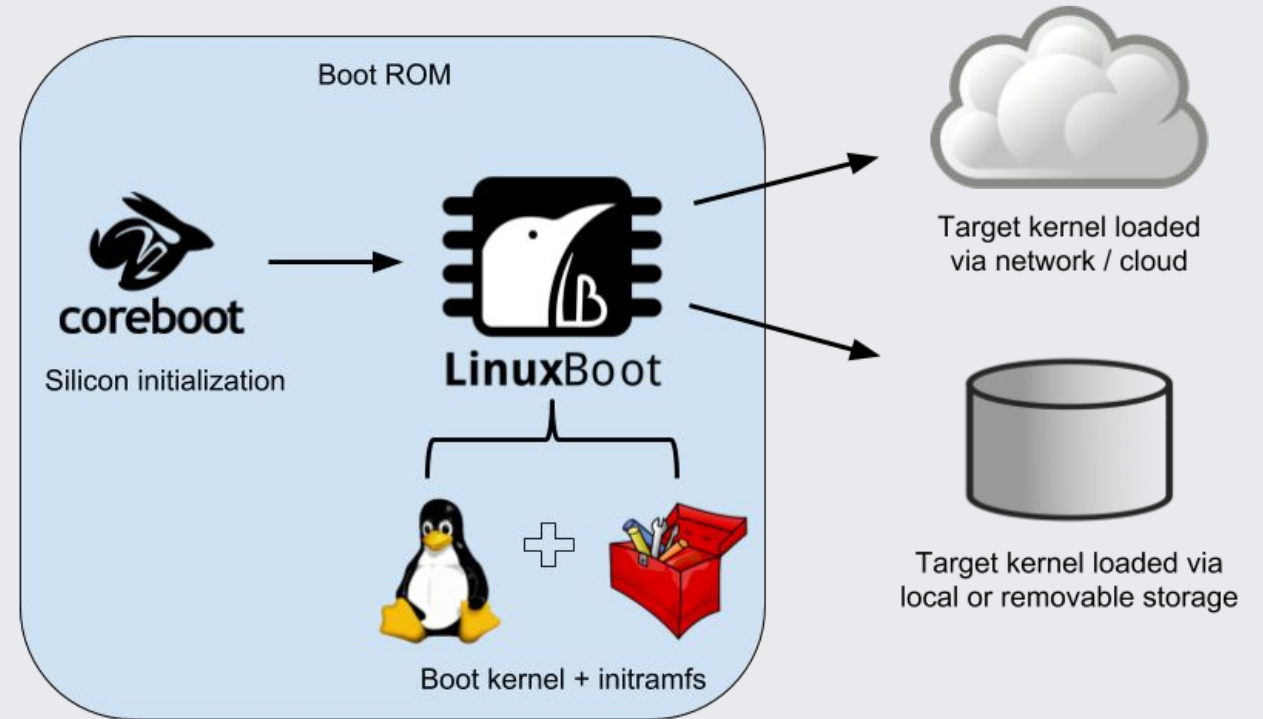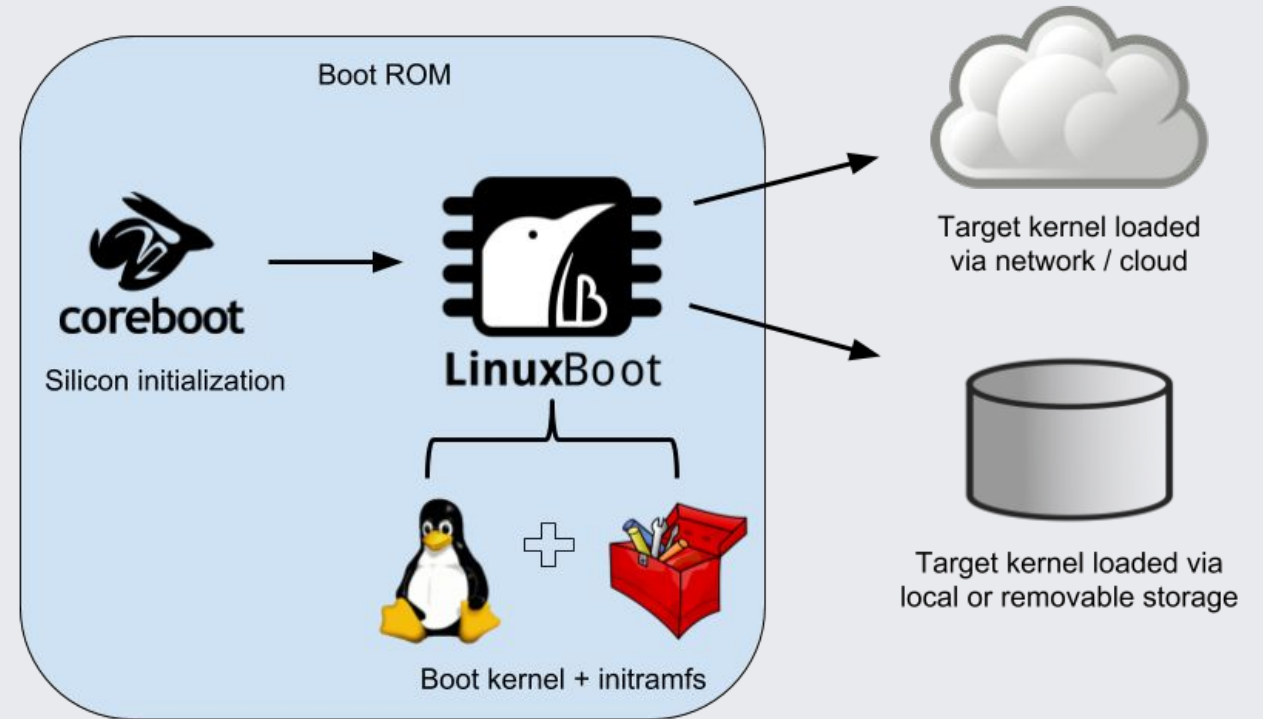# Let Linux Do it

- Put a kernel+initramfs in boot ROM
- Do minimal silicon init and jump to Linux as soon as possible
- Use Linux to boot Linux
- Production-quality drivers, networking
- **Add features + tools as needed**
- **Debug, build, deploy on our schedule**
- **Flexible security architecture**
- **Boot in seconds, not minutes**
- **Bring modern, open-source**

Boot ROM

coreboot
Silicon initialization

LinuxBoot

Boot kernel + initramfs

Target kernel loaded via network / cloud

Target kernel loaded via local or removable storage

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Scoping out the problem

Prineville, OR

Forest City, NC

Luleä, Sweden

Altoona, IA

Fort Worth, TX

Clonee, Ireland

Los Lunas, NM

Odense, Denmark

Papillion, NE

New Albany, OH

Henrico, VA

That's a lot of servers

(and switches, too!)

...and we're not just working on datacenters.
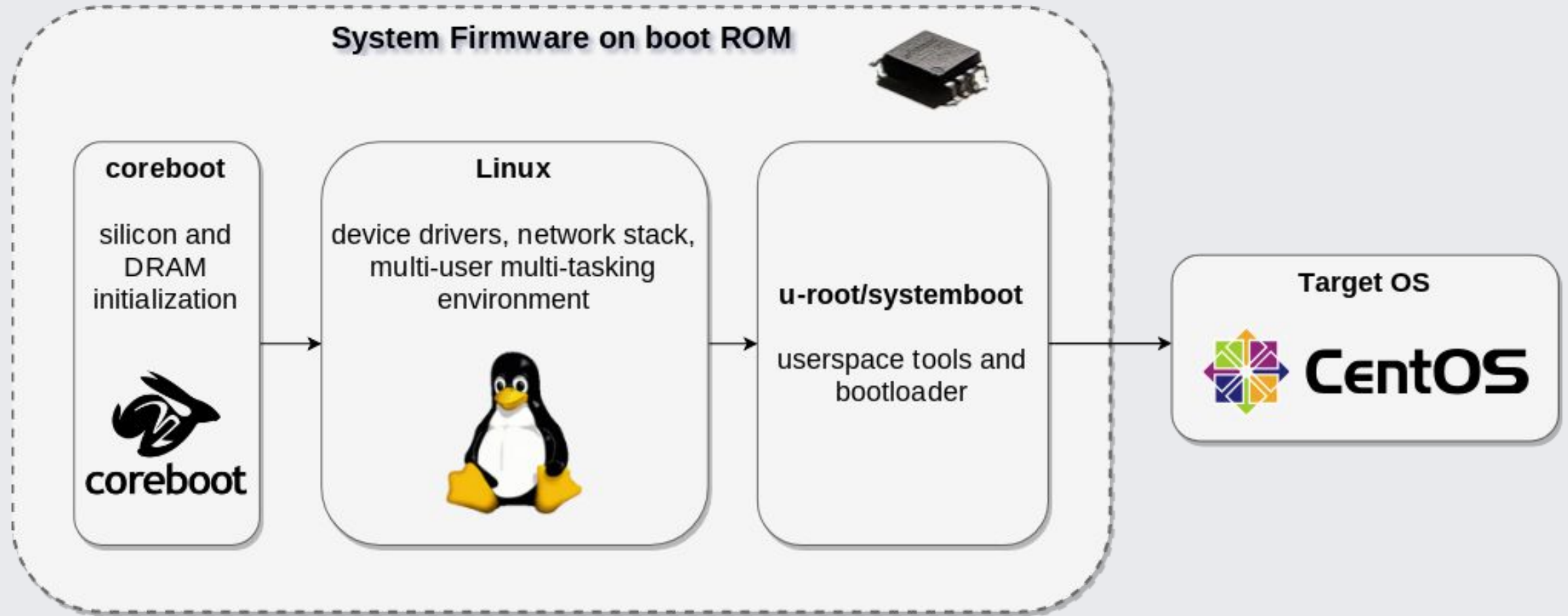
OCP Open System Firmware

Because if you don't own your firmware
your firmware owns you!

-- Ron Minnich

Hands on with LinuxBoot

- Andrea Barberio – Production Engineer @ Facebook
  Host Provisioning Engineering team

- Before we start: what are the LinuxBoot components?

LinuxBoot architecture @ FB

source: systemboot.org

Live demo (on a VM)

Thanks!

Questions?

David Hendricks <dhendrix@fb.com>

Andrea Barberio <barberio@fb.com>

Additional resources:
- linuxboot.org
- u-root.tk
- systemboot.org

- tpmtool.org
- opencompute.org
- telecominfraproject.com

(if you are here, the live demo failed)