

OPEN POSSIBILITIES.

LinuxBoot and coreboot at Google

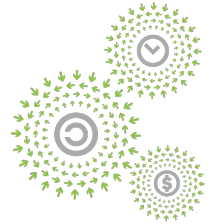


OCP
GLOBAL
SUMMIT

NOVEMBER 9-10, 2021

LinuxBoot and coreboot at Google

Ron Minnich, Staff Software Engineer, Google



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Current state



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- LinuxBoot effort started by Google Jan 2017
 - Linux kernel + u-root initramfs in FLASH
- Deployed at scale at Google by December 2020
- PoR for future servers and “servers”
- Deployed at other hyperscalars and companies too numerous to name
- Facebook/Intel coreboot partnership across 3 chipsets presented at OCP
- Google has made coreboot Plan of Record for future systems of any kind
 - Has been Plan of Record for chromebooks for 10 years
- coreboot@ByteDance: <https://inf.news/en/tech/73e123f55bf760adcd2d7d3fd6e91f82.html>
- Multiparty NDA coreboot efforts on various chipsets from various vendors

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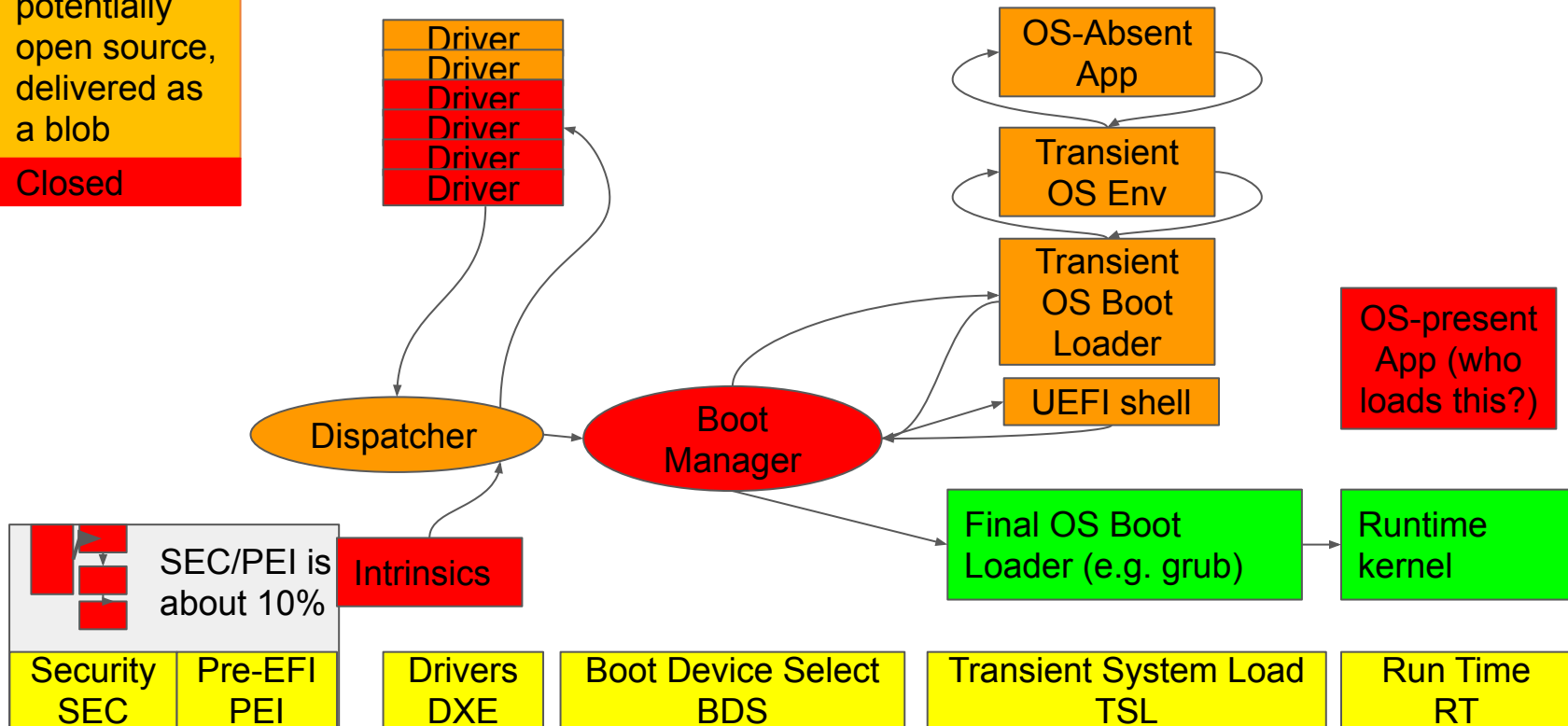


open source

potentially open source, delivered as a blob

Closed

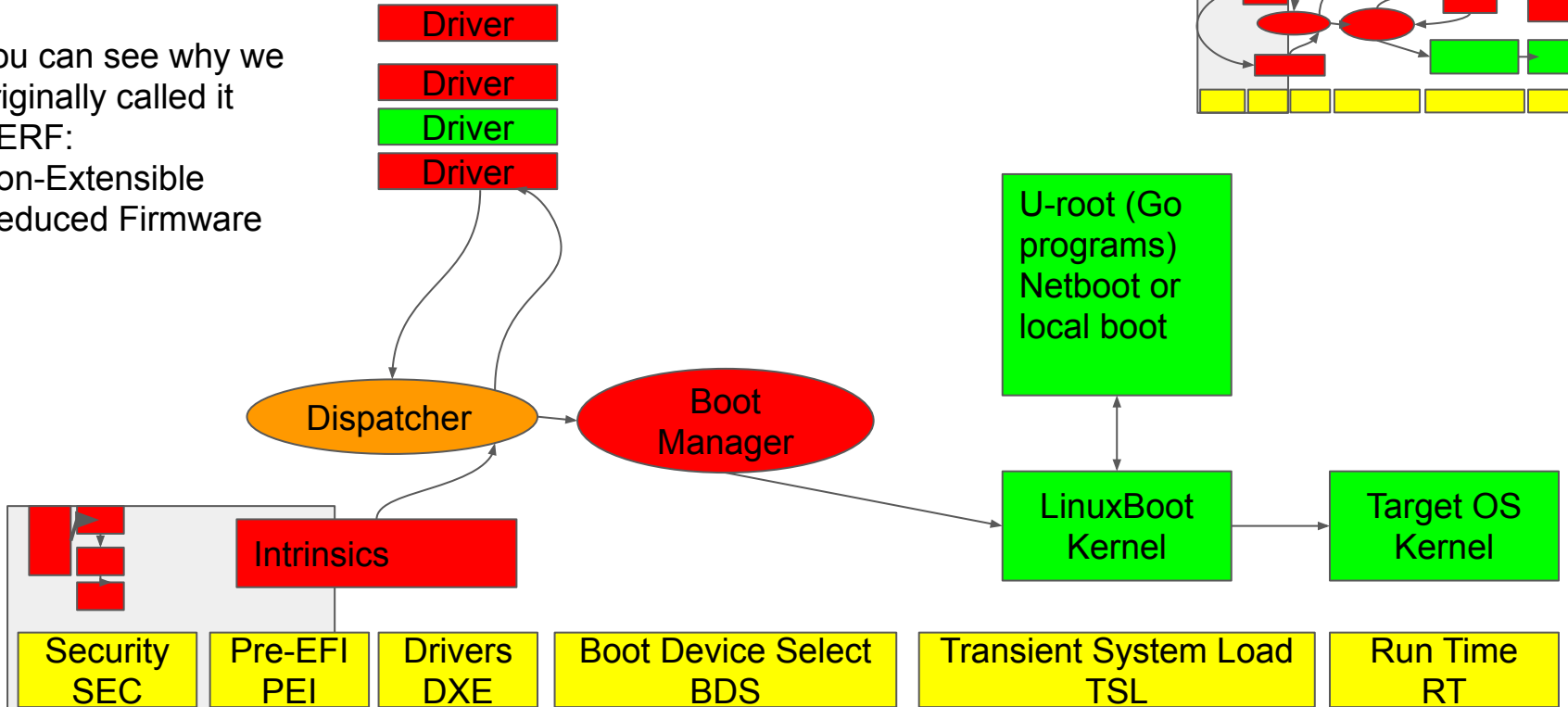
How we create LinuxBoot on UEFI



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LinuxBoot one UEFI: reduce & replace

You can see why we originally called it NERF:
Non-Extensible
Reduced Firmware



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LinuxBoot on UEFI results



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- LinuxBoot in UEFI systems deployed in aerospace, cloud, mfg in 2017
- Deployed in at least one hyperscaler in 2018
- Deployed in APAC companies 2019
- Deployed at scale in Google 2020
- Deployed at ByteDance in 2021
- Works across x86 and ARM (see: LBBR)
- Can use *same LinuxBoot binary on Intel and AMD*
- LinuxBoot allows us to “**reduce** and replace” *much of* UEFI
- coreboot allows us to “**remove** and replace” *the rest of* UEFI

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coreboot



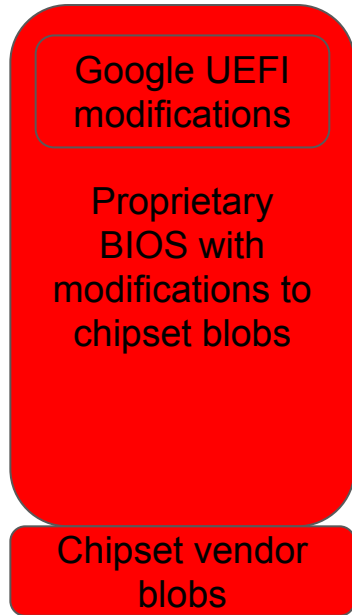
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- Started in 1999 as LinuxBIOS at Los Alamos National Labs (LANL)
- Literally that -- Linux as your BIOS
- Two parts:
 - Small startup code, purposely design to do as little as possible -- “Let Linux Do It”
 - On one chipset I got it down to 200 bytes
 - Linux kernel
- Used in several Top 10 supercomputers in early 2000s
- German gov’t sponsored laptop support 2006-2008
- Used in x86 chromebooks since 2011 and ARM chromebooks since 2014
- Tesla picked it up in (??) 2017?

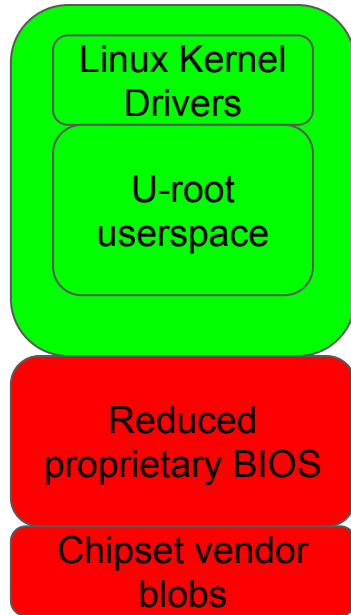
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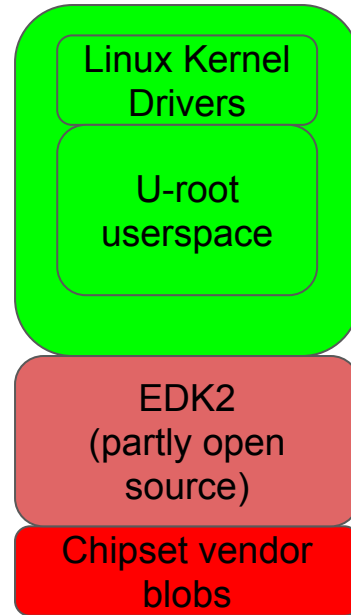
Google's path to coreboot



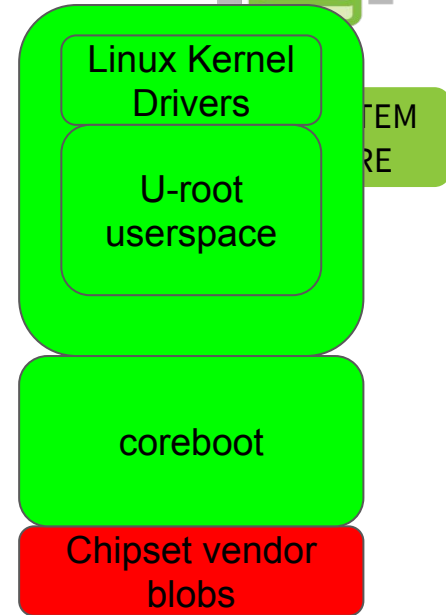
Restrictive licensing
Almost no common code



Linux kernel burned into flash
Drivers reused from as needed
About 50% common code across a single architecture



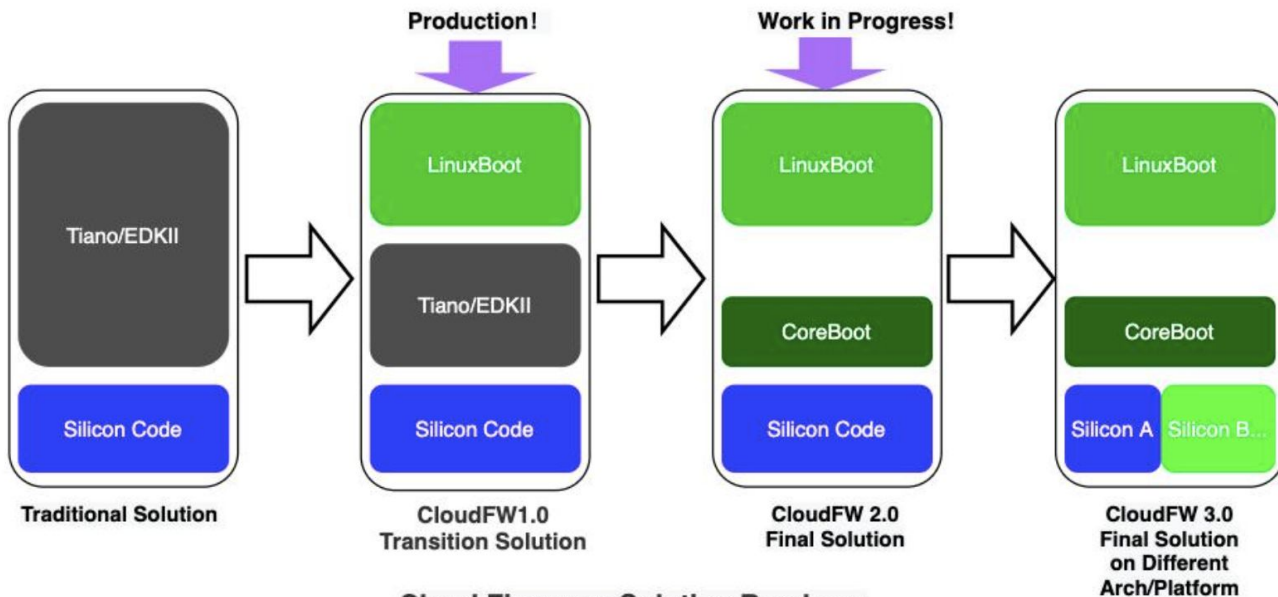
More minimal init provided by CPU vendor
About 50% common code across all architectures



Mostly open source
All open standards
Community can do more
Common platform across NPIs
Higher confidence in security
About 90% common code across all architectures

ByteDance path to coreboot – parallel evolution!

(<https://inf.news/en/tech/978971dd4eb2da9aab33ad09cb970410.html>)



Cloud Firmware Solution Roadmap

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How coreboot improves security

- Statically linked
 - critical to security analysis
- Open source code base
 - *NOT* “many eyes” -- that’s known to fail
 - “Many highly skilled eyes” -- that’s known to work
- Twenty years of hardening in the open community
- Imported into coverity over ten years ago
- Hardened for chromeos (consumer devices) for 11 years



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How coreboot improves quality

- Compact codebase
- Large set of contributors
- 90% of code is common to all boards
 - “Fix one, fix all” is a common experience
- Full build for 252 mainboards for each commit
- One codebase for 252 mainboards, 5 architectures



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How coreboot helped one project at Google



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- Board had 228 DXEs (UEFI drivers)
- We removed 122
- Some removals seemed to work, had adverse impact later
 - Nobody from chipset vendor, board vendor, or Google could ever be sure
- We had a real struggle to free up even a few MiB
- UEFI was getting to be difficult to work with

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Moved to coreboot and Intel FSP

- Freed up 10 MiB instantly
- Reduced number of fingers in firmware pie
- Allowed us to really understand what was going on
- enhanced security
- faster boot

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Conclusion

- LinuxBoot started out as a UEFI project
- Allowed us to remove a *lot* of UEFI
 - Led companies to question: “do we need UEFI?”
- Companies started to push hard for coreboot
- And here we are today:
 - Intel SPR: facebook, Intel, ByteDance, WiWynn, ... Google
 - AMD Rome: Google, Datacom Electronics GmbH, others (not sure I can name them)
- Surprise: making a project explicitly UEFI+LinuxBoot led to coreboot+LinuxBoot



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Call to Action



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- open system firmware slack: <https://slack.osfw.dev/>
- coreboot is available for OCP DeltaLake server based on Intel Xeon Scalable processor
 - see the OCP Github for open system firmware (OSF)
 - [https://github.com/opencomputeproject/OpenSystemFirmware](https://github.com/opencomputeproject/OpenSystemFirmware/tree/master/Wiwynn/deltalake)
 - /tree/master/Wiwynn/deltalake
 - With more to come in 2022!
- linuxboot.org

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Thank you!



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