# Verified Boot and firmware updates

How to do them securely and openly

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### whoami

- Michał Kopeć (original author)
  - Firmware Engineer at 3mdeb since 2021
  - Develops Dasharo for laptops, network appliances and other platforms
  - Uses Arch btw
- Michał Żygowski (presenter)
  - Firmware Engineer at 3mdeb since 2017
  - Develops Dasharo
  - open-source, HW and security features enthusiast



### Agenda

- Verified Boot
  - in Chrome
  - in Dasharo
- Problem statement
- Boot Guard
- CBFS verification
- Secure firmware updates



- Verified Boot: Cryptographic verification of the boot process to ensure only code from a trusted source (e.g. device vendor) can run
- coreboot supports Vboot, Google's version of verified boot scheme
- Vboot has:
  - A root of trust
  - Verification of subsequent firmware stages
  - Signatures and public tools for self-signing
  - A special A/B update mechanism
  - Support for re-ownership
- Dasharo uses Vboot





- Write protection: WP# pin on the BIOS chip
  - WP# pin is controlled by Cr50 security chip (newer devices) or physical screw (older devices)
- Updates: An OS service handles the A/B update scheme
  - One slot is updated, and when confirmed bootable, the other slot is updated too
- Write protected portion of the flash is **not** updated, and serves as recovery
  - WP region contains the initial bootblock and verifies the A/B slots
  - When both slots fail or recovery is manually requested (e.g. by keyboard key), the firmware boots from the recovery partition



### Verified Boot in Dasharo



- Write protection is provided by chipset (typically, can be also SPI WP#)
  - Optional feature, but enabled by default for most platforms
  - Protects against software attacks
- Updates are handled by Dasharo Tools Suite
  - Capsule Update and fwupd support is WIP
- Most updates also need to update the bootblock, so they require protection to be disabled for updates obviously suboptimal
- OS secure boot is handled by UEFI SB



### Problem



- How do we improve Dasharo verified boot while staying secure and without taking control away from users?
  - Security: A guarantee that only firmware from a trusted vendor is run
  - Control: Ability to self-sign, to inspect and replace firmware components
- There are other verified boot schemes

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### Intel Boot Guard



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#### About this item

- \[ adjustment]: The hip protector is designed with a hook and loop as a whole, which makes it easy to wear out and can be adjusted freely.
- \{Thickening protection pad]: The seat body design is more flexible and safer, and the thick EVA
  protection pad (25MM) is light, comfortable and fmm. The bumps and bumps of the protective pad can
  absorb vibration and prevent slippage, which can effectively reduce vibration and impact.
- \[Good protection ability]: When children are skiing, snowboarding, skating, figure skating, skating, skateboarding, special protection is added to the tailbone, which can increase the force area when falling and greatly reduce the impact.
- \[High-quality material]: The lining of the child's buttocks protection pad is made of polyurethane fiber cotton, which is soft, skin-friendly, comfortable, breathable, and more to move.
- \[Guarantee]: If you are not satisfied with the product we received, you can apply for an unconditional
  return and refund within 180 days. For any questions about this product, you can send us an email at
  any time. We will reply to you as soon as possible.

Source: <u>Amazon</u>

- The most widely known option
- Verifies and measures the initial bootblock
- Ensures FW authenticity using keys fused to the chipset
- Different profiles with different features enabled
  - Verified boot is always enabled in all profiles
- Ties a platform to a specific firmware vendor, forever!



### **Boot Guard cons**



Antu selinux CC BY-SA 3.0

- Requires more blobs in firmware
  - Boot Guard ACM
- Fusing removes some owner control
- Profile 3 does not ensure initial boot block authenticity
  - Only helps us establish a root of trust for measurement
- Other profiles take away owner control completely



### **CBFS Verification**



- A relatively new coreboot feature
- Cryptographically verifies components of the coreboot image
- According to documentation:

This only makes sense if you use some out-of-band mechanism to guarantee the integrity of the bootblock itself, such as Intel Boot Guard or flash write-protection.

- Same applies to vboot's recovery region, which is ultimately trusted
- Depends on some other mechanism for signing (e.g. Boot Guard)
- Can effectively replace the portions of Vboot that Dasharo uses



### Firmware updates

- Chrome Vboot: A+B+RO
  - A and B slots for updates, RO slot contains IBB and verification code
  - Anti-rollback using TPM
  - Vboot aware OS service manages slot updates
- Dasharo:
  - Initial idea was to leave RO untouched and only update A/B slots
  - In practice, most updates introduce breaking changes that require updating the bootblock
  - Dasharo Tools Suite handles updates, does the entire update in one operation
  - So we don't use the A/B feature
  - Capsule Updates may help here



## Other firmware update mechanisms



The Flash Wallpaper by kelso CC BY-SA 3.0

- Flashrom plugin in fwupd
  - Updates the BIOS region only
  - Is not Vboot aware
- UEFI Capsule Update
  - Most widely used in proprietary UEFIs
  - Can be made aware of which regions to update and which to preserve, verify signatures, handle disabling flash protections
  - WIP for Dasharo

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- Intel BIOS Guard
  - Hooks into the SMM flash update handler to call an ACM, which authorizes flash writes
  - Can bypass chipset flash protections and Top Swap (configurable with MFIT/FIT/FITC in flash descriptor straps)
  - Can also handle EC updates
  - Proprietary feature with proprietary tooling
- Top Swap
  - Redundant bootblock feature
  - Configurable from 64KB up to 4M/8MB (maximum depending on CPU/SoC/chipset family) in flash descriptor straps (MFIT/FITC/FIT)
  - Potential integration with vboot?

