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Arm Solutions at Lightspeed

WoA laptops: a quest for getting the right DTB

Dmitry Baryshkov
Christopher Obbard

WoA (WoS) laptops

- Windows on Snapdragon
  - 19 models supported by Linux (6.13) and counting
    - Starting from MSM8998 up to X1 Elite
- Boot flow using UEFI + ACPI, no DeviceTree support by default
  - Lenovo ThinkPad X13s was extended to support DT after shipping
- ACPI tables are largely unusable in Linux because of PEP (Platform Extension Plug-ins)
- Therefore booting generic arm64 distro ISO not possible…
- A quest for the right DT to be provided to Linux kernel

A quest for the suitable Device Tree

Normal boot

- DT must be known during boot, it can be specified via bootloader config

First boot (aka installer image)

- Installation media contains all DTB
- DTB should be automatically selected

Normal “SecureBoot” boot

- Bootloaders reject “extra” configuration
- Everything needs to be signed

Possible solutions

- ACPI for the first boot, DT afterwards
  - ACPI is mostly unsupported and largely untested

- UEFI provides DTB
  - Would “just work”
  - Long way from that
  - Need to support existing devices (only X13s can load DTB from ESP)

- Choose DTB to load based on ACPI DMI information
  - CHIDs (“ComputerHardwareIds”) are unique identifiers which can be used to determine hardware
  - Various entries containing: Manufacturer + Family + Product Name + SKU Number + BIOS Vendor + BIOS Version + BIOS Major Release + BIOS Minor Release
  - CHIDs can be mapped to a specific DTB

DtbLoader

- DtbLoader UEFI driver (original implementation)
  - Requires cryptic DT names
  - SecureBoot case is problematic
  - Grub systems need separate solution

- DtbLoader UEFI app
  - Needs to be updated to support new devices

- Advantages
  - It works!

- Disadvantages
  - Extra binaries change bootloader chain
  - DTB isn't signed

Systemd-boot UKI DTB Loader

- UKI & systemd-boot
  - Introduced in systemd v257
  - Allows the DTB to be loaded from UKI based on CHID (using same logic as DtbLoader)
  - Inject DTBs and a mapping of CHID->DTB at UKI build-time

- Advantages
  - Everything is signed in the UKI
  - DTB mapping can be updated independently of boot binaries

- Disadvantages
  - Only supports booting with UKIs
  - No central repository for CHID mapping (yet)
  - UKI can become quite large with DTB & CHID mapping data
  - Requires systemd-boot (Debian is currently using Grub)

Possible implementation... U-Boot loads DTB

- Chainload U-Boot which handles everything

- Not sure we need to explain the disadvantages of this one...
- Flexibility of U-Boot complicates things, in secure-boot world

Possible implementation... Shim loads DTB

- Patch the Shim
  - Just kidding...
  - Or maybe not!

- Advantages
  - No large change to existing boot chain
  - Easy integration into Debian/Fedora

- Disadvantages
  - Requires DTBs to be signed for secure boot

Distribution support

- Debian
  - Grub-based boot flow
  - ISO installation media with Grub
  - Currently no upstream solution…
  - Chris has built custom images with systemd-boot UKI approach
- Fedora
  - Blocked due to not being able to load DTB
- Arch
  - No installer, no problem?
  - Community-based images with systemd-boot UKI approach
- Ubuntu
  - Customized for platform type?
  - Concept images for X Elite use GRUB script to determine DTB
- postmarketOS
  - Trailblazer images use DtbLoader EFI driver
- Others?

Next steps

- Finalise concept images for Debian/Fedora

- Form working-group between vendors & distros
  - Who would be interested?
  - Mailing list / group?
  - Who drives it?

- Decide on common solution suitable for various distros

- ...implement it !

Thank you!
Questions?
Opinions!