ARM Laptop BoF

LPC 2025

東京 2025
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TOKYO, JAPAN / DEC. 11-13, 2025

ChromeBooks

- Paved the way for Linux on ARM in a laptop form factor
- Good upstream support for various devices
- Good first choice for non-compute heavy uses cases

Asahi Linux

- AppleSilicon M1 & M2 (minimal support for M3 & M4)
- Heavy development created a huge backlog pending for upstream:
  “90,000+ lines of code added to the Linux kernel as of 6.13, across 1250 patches”
- Focus on upstreaming in 2025
- Graphics driver in Mesa and kernel

MetaComputing ARM AI PC

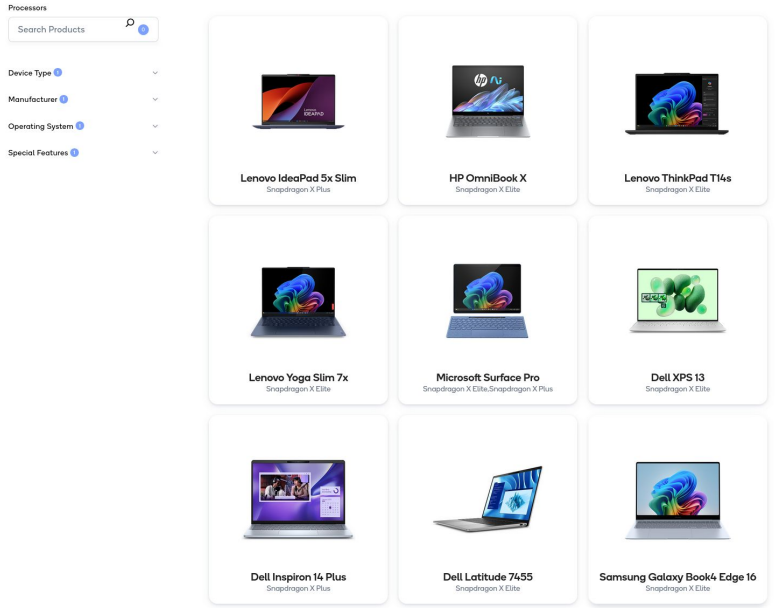
- Compatible with Framework Laptop 13
- SoC CIX P1 (CP8180) ARMv9
  - 12-core
    - 4x Cortex-A720 big cores @ up to 2.6 GHz
    - 4x Cortex-A720 medium cores
    - 4x Cortex-A520 LITTLE cores
  - GPU – Arm Immortalis G720 MC10
  - VPU accelerated decode and encode
  - AI accelerator

https://metacomputing.io/products/metacomputing-aipc

Snapdragon X Elite

- Snapdragon X Elite launched in June 2024
- Devices from Lenovo, Dell, Asus, Acer, HP, Microsoft, Samsung, Medion, Honor, etc.
- Currently 118 devices listed by 8 manufacturers
- Snapdragon X Plus rolled out for mid price range

https://www.qualcomm.com/products/mobile/snapdragon/laptops-and-tablets/snapdragon-x-elite
https://www.qualcomm.com/products/mobile/snapdragon/laptops-and-tablets/laptop-device-finder



Processor	Qualcomm Oryon CPU				Qualcomm Adreno GPU	Qualcomm Hexagon NPU	Memory	
	Cores	Total cache	Max Multi-Core Frequency	Boost Frequency	TFLOPS	NPU TOPS	Memory Type	Transfer Rate
Snapdragon X Elite								
X1E-00-1DE	12	42 MB	3.8 GHz	4.3 GHz (Dual-Core)	4.6	45	LPDDR5x	8448 MT/s
X1E-84-100	12	42 MB	3.8 GHz	4.2 GHz (Dual-Core)	4.6	45	LPDDR5x	8448 MT/s
X1E-80-100	12	42 MB	3.4 GHz	4.0 GHz (Dual-Core)	3.8	45	LPDDR5x	8448 MT/s
X1E-78-100	12	42 MB	3.4 GHz	None	3.8	45	LPDDR5x	8448 MT/s
Snapdragon X Plus								
X1P-66-100	10	42 MB	3.4 GHz	4.0 GHz (Single-core)	3.8	45	LPDDR5x	8448 MT/s
X1P-64-100	10	42 MB	3.4 GHz	None	3.8	45	LPDDR5x	8448 MT/s
X1P-46-100	8	30 MB	3.4 GHz	4.0 GHz (Single-core)	2.1	45	LPDDR5x	8448 MT/s
X1P-42-100	8	30 MB	3.2 GHz	3.4 GHz (Single-core)	1.7	45	LPDDR5x	8448 MT/s

Open Hardware

- Pinebook https://pine64.org/devices/pinebook/
- MNT Reform laptop https://shop.mntre.com/products/mnt-reform

End-to-End Use-cases

- Bootchain
- Thermal support
- Camera support for application and browser
- Video offload support for application and browser

Bootchain - DT

- Problem:
  - ACPI implementation incompatible with Linux (due to ACPI PEP)
  - Installation media needs to be augmented with the correct DTB and matched to the device during boot.
- Impact:
  - Poor Distro installation experience
- What is going on?
  - Unified Kernel Image (UKI) as UEFI PE file contains kernel, initrd, cmdline, DTB(s)
  - Computer Hardware IDs (CHIDS) are used to map device/SKU to DTB within UKI
  - UKI support exists in systemd-boot and Grub support is supposed to come soon
  - Still no solution for out of box booting and DTB selection
    - Package DTBs in the UKI image and use systemd-boot to choose the correct DTB based on HWID
- Devicetree loading for dummies (EFI edition) by Casey Connolly Saturday in DeviceTree MC
- Canonical uses stubble: UEFI kernel boot stub to load machine specific DT

Bootchain - ACPI

- Problem:
  - ACPI implementation incompatible with Linux (due to ACPI PEP)

- Full ACPI boot on ARM64 is lacking
- Needs full validation outside of Windows (and the PEP model)
- Specification gaps
- Firmware implementations for available devices

Thermal

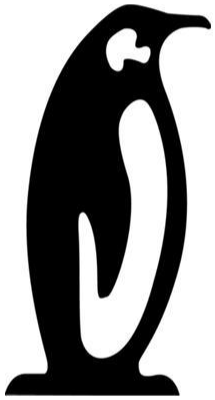
- Problem:
  - Linux, Embedded Controller (EC) and battery/charging need to work together to maximize performance while maintaining safe temperatures
  - Thermal design and EC differs on most laptops
- Impact:
  - Laptop shuts down due to high temperatures
  - Throttling CPUs for managing skin temperature - Inefficient
  - Relevant thermal domains are not throttled using their cooling devices
- What is going on?
  - CPU/GPU/DSP Thermal Management
  - Skin temperature monitoring and regulation
  - EC driver, fine tune passive cooling (throttling) vs active cooling (fan)
  - Performance vs Thermal Management
  - Implementation in kernel vs userspace

Camera

- Problem:
  - No ISP
  - On Linux laptops libcamera is the defacto standard for integrating camera systems into cheese, gstreamer and via pipewire into Firefox, Chromium and Zoom
- What is going on?
  - SoftISP in CPU, libcamera now supported.
  - Browsers support, upstream but requires configuration via about:config to enable pipewire
  - SoftISP in GPU, libcamera works in process of upstream, saves a lot of CPU time still inferior to enabling silicon specific support in camera block.

Video offload

- Problem:
  - Video encode/decode has some level of support and integration, but requires some additional work to bring to a “it just works” level.
    - There are two domains where the gaps are most obvious.
      - Web browser integration
      - Popular user-space video lib integration
- Impact:
  - No end-to-end use of HW acceleration.
- What is going on
  - Chromium browser support WIP, V4L2 stateful and stateless support is enabled in Chromium
  - Ongoing investigation on making v4lm2m a first-class hardware accel method in ffmpeg.



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