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Arm Solutions at Lightspeed

ARM64 Linux Laptops Status Report

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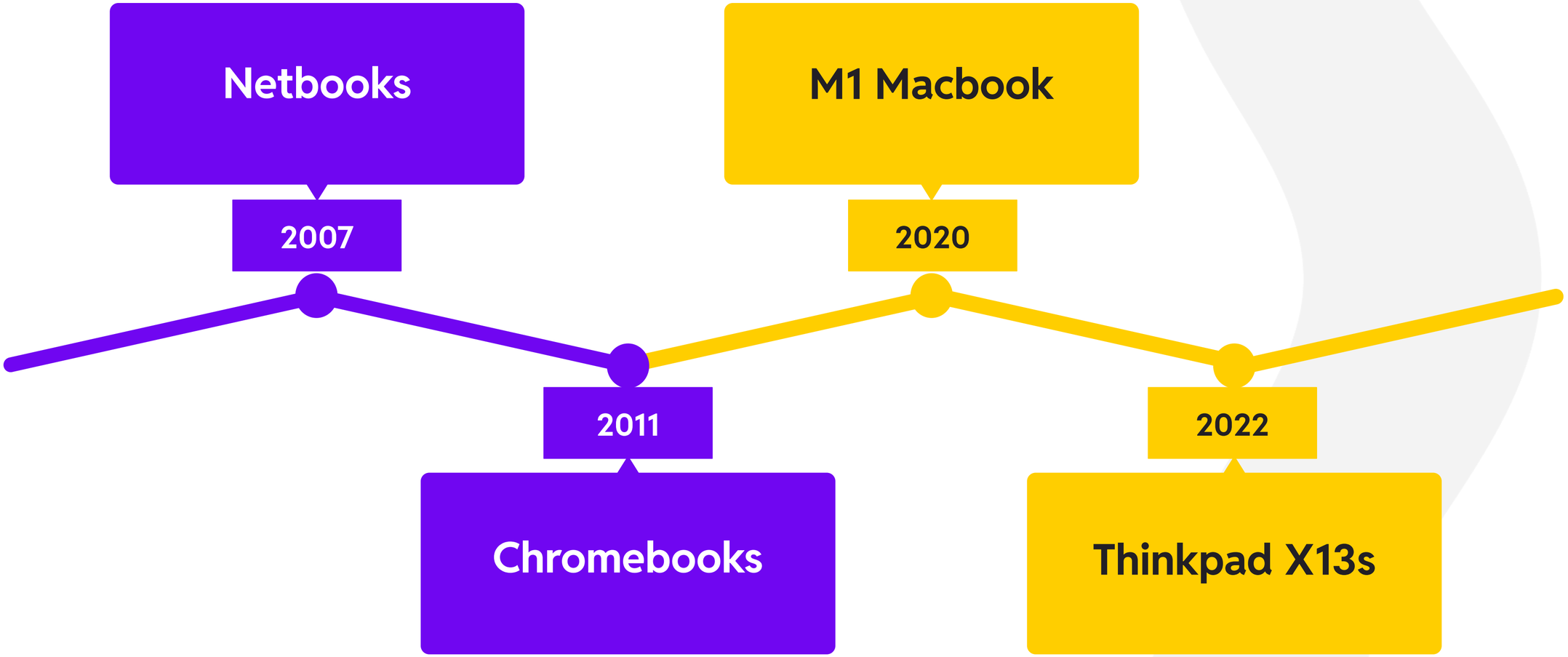
Agenda

- ARM Laptop History
- Installation
- Upstream Support
- Daily Driver
- Known Bugs & Limitations
- Tips & Tricks
- Summary

ARM Laptop History



Asahi Linux

- Not an active user or developer, outside view
- Project restructured itself in the beginning of 2025
- 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” [1]
- Focus on upstreaming in 2025
- Regular status reports on new kernel releases
- In 6.15 graphics driver uAPI has been merged to facilitate Mesa development

[1] https://asahilinux.org/2025/03/progress-report-6-14/

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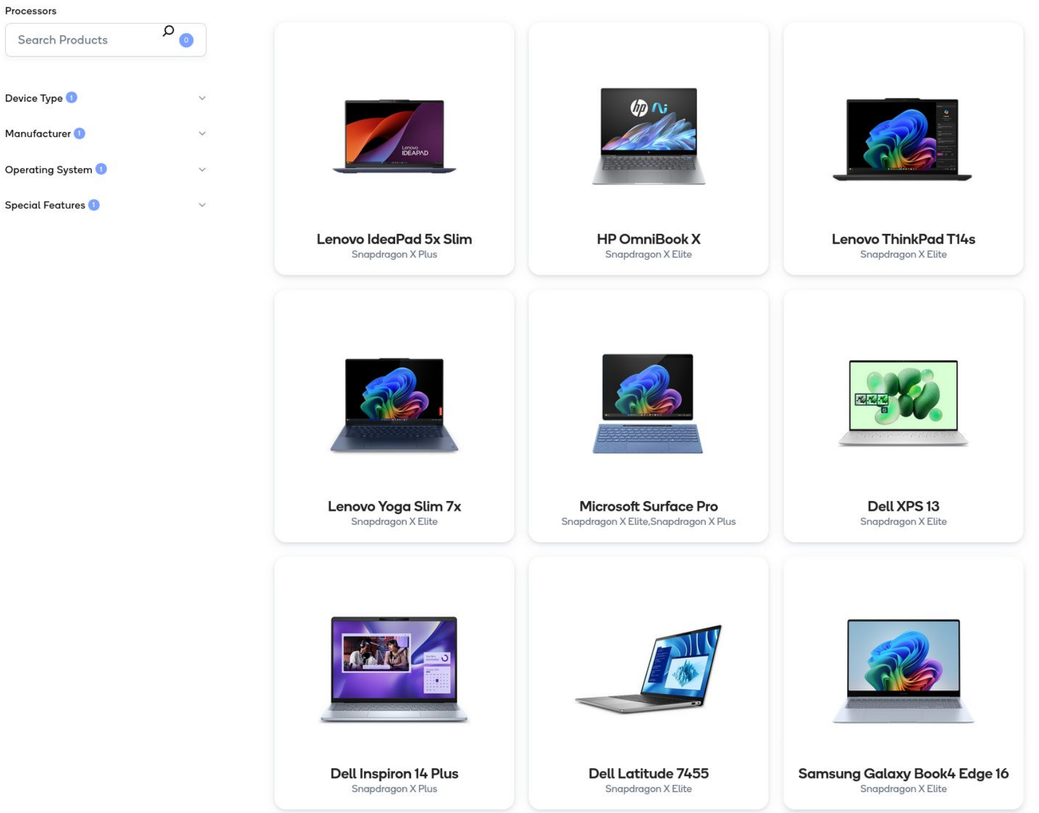
X Elite

- 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
- Overall a good price, aesthetics and manufacturer range, freedom of choice
- Celebrating 1 year anniversary

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

Booting

- Windows-on-ARM
- UEFI booting + ACPI device description and discovery

- ACPI implementation uses Platform Extension Plug-ins (PEP) and has some empty ACPI tables
- Making it incompatible with the Linux ACPI implementation
- No DTB provided by boot firmware/UEFI

- On devices with 64GB memory, Grub might need to be limited to 32 GB only

Installation

- Installation media needs to be augmented to provide DTB
- Hassle for individual install and scaling problem for distro installers

- Unified Kernel Image (UKI) supports DTB include now
- UKI support in systemd-boot and patches for Grub posted

- Computer Hardware IDs (CHIPS) are used to map device/SKU, many permutations possible
- Scaling problem for matching and shipping DTBs in distro installer

- Alternatively a UEFI variable be set with a purpose build tool before installation

Upstream Support

- Upstream support varies a lot between devices
- Common SoC support is only the base
- Correct device-tree description needed
- Sometimes firmware or specific device quirks
- Latest linux-firmware is also expected for GPU, Wi-Fi, Bluetooth, ADSP and CDSP firmwares
- pd-mapper userspace service or in kernel version

Qualcomm upstream support heatmap at: https://linaro.github.io/msm/

T14s support table by Johan Hovold: https://github.com/jhovold/linux/wiki/T14s

Exemplary T14s Upstream Support

Audio (headset)	6.14 (6.16)	PCIe x4	6.12
Backlight	6.16	Remoteproc	6.12
Battery	6.12	RTC	wip branch
Bluetooth	wip branch	Suspend	6.12
Camera	started	Thermal sensors	started
CPUfreq	6.16	Touchpad (alternate)	6.12 (6.13)
Display (OLED)	6.12 (wip branch)	Touchscreen (alternate)	6.12 (-)
EFI variables	6.12	TPM	-
Fingerprint reader	6.14	USB-A	6.14
GPU	6.12	USB-C	6.12
HDMI	-	USB-C DisplayPort Alt Mode	6.16
Hibernation	-	USB-PD	6.12
Keyboard	6.12	Video acceleration	started
Keyboard special keys	-	Virtualisation (EL2)	slbounce and -el2.dtb
Modem	6.16	Watchdog	6.16
NVMe SSD	6.12	Wi-Fi	6.12

Beyond Kernel Support

- Video encode / decode hardware offload
  - 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.

- Camera
  - SoftISP in CPU, libcamera now supported.
  - Browsers support, upstream but requires configuration via about:config to enable pipewire
  - GPUISP libcamera patches have been posted

- Thermal
  - Combination of Linux, Embedded controller and charging/battery control
  - Throttle and actively cool to enhance performance and avoid skinburn
  - Thermal design device specific

Regular Daily Usage

Pros

- Comparable performance to current Intel
- Working GPU acceleration with mesa 24.2 and Freedreno
- Most needed firmwares are available in linux-firmware
- Distro’s have aarch64 package repositories
- FEX-EMU for x86_64 binaries and gaming

Cons

- Installation
- WIP power collapse and suspend savings
- Firmware limitations
- System instabilities (thermal and firmware)

Known Bugs & Limitations

- Speaker protection needed, ensure your speaker volume is down to a minimum
- Not entering power collapse for suspend battery savings
- Camera sensors might no be enabled on all devices
- Problems with full amount of RAM on 64GB devices
- Only Lenovo does ship firmware in linux-firmware

Developer Daily Usage

- Kernel build time: 2 min
- Chromium Debian package build time: 5h
- Full native Yocto builds
- Full work day battery usage
- Full breadth of Debian Trixie packages available
- Continuing effort from Qualcomm, Linaro and the community on upstream support

Tips, Tricks and Hopes

- Keep your Windows installation for firmware files and UEFI updates
- Disable bitlocker disk encryption on Windows
- Be comfortable to build your own kernel
- Be comfortable to create initrds, Grub configs, etc
- Try both orientations with USB-C connections
- IRC OFTC #aarch64-laptops channel

Linux by default?

- Tuxedo working on X Elite based laptop with Linux
- Maybe developer editions from Dell and Lenovo?

Summary

- Finally a good range of capable ARM64 laptops suitable for developers
- The initial installation is currently painful
- Distro kernels are not fully ready yet for daily use (getting there)
- Hardware support has some WIP, but solid state and ongoing work on the remaining
- Works for tech savvy early adaptors, not so much for normal users

- Hope: choice of Linux as OS by manufacturers

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Thank you