A networking chip at the heart of an Arm-on-Arm workstation?

Daniel Thompson and Ilias Apalodimas Linaro



Overview

- Hardware
 - NXP Layerscape LX2160A
 - Solidrun Honeycomb LX2 (featuring the LX2K CEx7 Computer-on-Module)
- Firmware
 - $\circ \quad \text{Vendor UEFI and u-boot} \\$
 - Upstream status
- Kernel
 - Upstream status and known working distros
- Living the Arm-on-Arm dream
- Honeycomb LX2 as a development platform



NXP Layerscape LX2160A

















Hardware

- The Good
 - Powerful stable hardware
 - Cortex A72 capable of executing all three Arm instruction sets (A64, A32, T32)
 - Standard form factor and connectors: Mini ITX, fan, "northbridge" mounts for heatsink, USB headers, front panel pins, etc.

• The Bad

- No back cutout panel
- Loud 40mm CPU heatsink fan
- Micro BMC reset line does not work (this is minor since we reboot with power off/on)

• The Ugly

x16 cards don't detect reliably (open back x8 slot doesn't have conductors to detect x16 card presence and review of schematic did not suggest a way to force presence detect)



Heatsinks

We really mean it about that 40mm fan!

Almost everybody with an LX2K has a custom cooler.











There are **several firmwares** available for Honeycomb LX2

Fully **packaged** for turn key **builds**:

- Vendor EDK2 https://github.com/SolidRun/lx2160a_uefi
 - EFI compliant boot from: USB, SATA, NVME, eMMC*, SD*
 - PWM fan control...
 - "Overclocked" memory profiles
- Vendor u-boot <u>https://github.com/SolidRun/lx2160a_build</u>
 - Also solid and reliable but firmware does not provide any DT making it difficult to boot distro installers
 - Can be integrated with Debian/Ubuntu using u-boot distro boot protocol

Upstream:

- U-boot
 - Mature enough to allow Honeycomb to be used to develop new u-boot features
 - Does not include yet include all "comfort" features from vendor builds
- EDK2: WIP



* We did not test these ourselves

Firmware

There are **several firmwares** available for Honeycomb LX2

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If you **do not** have any reason to **prefer one** other another and **want** your firmware to "**just work**" then **use this one**!

Firmware - Certification "in progress"

The vendor UEFI firmware for Honeycomb LX2 is currently undergoing Arm SystemReady ES certification.

For more info on SystemReady check out the videos from Tuesday, especially **SystemReady SR and ES: Standards for servers and the Edge**

Thanks to Samer El-Haj Mahmoud and Dong Wei (Arm) for these slides.



/IRTHAL + SPRING 20

Kernel - Devicetree

- Significant upstreaming work undertaken by both the silicon and board vendors
- Tested using the vendor u-boot implementation
 - All hardware we have been able to test is working as of v5.11:
 PCIe, USB3, USB2, SATA, UART, gigabit ethernet, eMMC, SD, temperature sensor
 - Did not test suspend/resume or explore power management
- Support is starting to flow into distros
 - Debian bullseye (v5.10) kernel without modification has support for everything except for gigabit ethernet



Kernel - ACPI

- Devices with a mature ACPI model "just work"
 - PCIe, USB3, USB2, SATA, UART, EFI framebuffer, temperature sensor*
 - Can run **"old" distros** on brand **new hardware**
 - CentOS 8 (v4.18), Debian Buster (v4.19), ...
 - Requires USB or PCIe for networking (just like Debian Bullseye with DT)
- "SoC" devices that require new ACPI drivers are a work in progress
 - ACPI also benefits from upstreaming work undertaken by both the silicon and board vendor
 - SolidRun has an "upstreamish" v5.10 kernel with an additional 44 patches to enable SD, eMMC, gigabit ethernet and (we suspect from changelog) also SFP+: <u>https://github.com/SolidRun/linux-stable/tree/linux-5.10.y-cex7</u>
 - Rebasing to v5.12-rc3 shows the patch count dropping to 33 (with many of the remaining patches posted or reposted during the v5.13 dev cycle).
- * We only tested thermal sensor with recent kernels (because Daniel forgot about it)



Livin' the dream - Boring!

Perhaps this will be the last time anyone can sneak into a conference schedule simply by adopting a 64-bit Arm workstation as a daily driver for three months. **No more free lunches for presenters like us** :-(.

Most of the time one forgets that we are running an "exotic" combination of hardware and software. **Boring has** (finally) **won**!

Lots of ecosystem progress since 2017:

- 16 x 2GHz hardware is "**fast enough**" (except when paginating large documents in Javascript based word processors)
- Fewer sites engage mobile mode when the see Arm in the user agent string
- Most OpenEmbedded builds now work (Go fixed since on Gatesgarth)
- Many more projects are shipping binaries for AArch64
 - Including Arm GNU-A and GNU-RM toolchains



Livin' the dream - The elephant in the room

Arm has already returned to the desktop... but it's not running GNU/Linux yet!











Livin' the dream - No Widevine

Many different streaming services require Widevine... ... happily I don't need to watch movies whilst I am at work... ... and I can stream audio from my tablet.

Widevine CDM is included with Google Chrome and Mozilla Firefox binary releases but neither browser provides Arm releases for GNU/Linux systems. Both Chromium and Firefox are packaged for most Linux distributions but the distro builds do not (and cannot) include Widevine plugins.

Workarounds for this are legally dubious: you don't have a Widevine license for your Honeycomb.



Livin' the dream - Video conferencing

- Just works
 - $\circ \quad \text{Google Meet} \quad$
 - Cisco Webex
- Needs coaxing
 - Zoom (no desktop app, web app is a second class citizen... and rather fiddly to run)

• Does not work

- Microsoft Teams (looks like it trying to connect... but you never enter the meeting)
- Desktop video clients are not practically useful in x86-64 in QEMU!
 - They do run... eventually!



Livin' the dream - Binaries are the final frontier

"What do we want?" AArch64 binaries.

"When do we want then?" Now!

Yes, we did realize that we are running an OS with a low market share on the desktop and running an architecture that has only recently emerged as a desktop player.

binfmt-support and **qemu-user-static** get us out of a tight spot and **allow us** to **run** not-performance-critical **software** but we still **want more binaries**:

- Mozilla Firefox (as a Mozilla authored flatpak if possible)
- Google Chrome
- Tensorflow (just 'cos all the cool kids seem to be doing it) pip install tensorflow does not work since the corresponding wheel lacks AArch64 binaries
- Desktop apps for video conferencing (or better web apps)



Honeycomb LX2 as a development platform

Honeycomb LX2 can be more than just "your desktop". It can also be used as a development platform to help push forward other parts of the Arm ecosystem.

And these are just some of the things we know about!



Development - Self hosted builds

- A powerful board gets the Arm world closer to full self-hosting
 - Linux kernel (5.12-rc3 arm64 defconfig) 11 mins 12 seconds
 - U-Boot (QEMU arm64 defconfig): 12.9 seconds
 - "Faster than most laptops, slower most build servers" (assuming 4 cores on a laptop and >=8 on a build server ;-))
- KVM
 - Fast VMs... for all three Arm instruction sets
- glmark2 score
 - GT-710: 1357 [llias] or 1852 [Daniel]
 - 3746 on AMD r9 380 [llias]
 - Issues do exist with amdgpu with Xorg programs and require some out of tree patches



Development - U-boot

U-Boot is has decent EFI support nowadays ...

- U-Boot can run an OS installer
 - Some distros fail on the final 'SetVariable'. The installation is completed but the system can't boot. You 'just' need to add grubaa64.efi in the Boot#### options.
- UEFI Secure Boot with variables stored in a secure world only I2C EEPROM or an RPMB.
- EFI Capsule Updates working
- EFI_TCG2 protocol for boot attestation available
- Runtime variables are working (minus SetVariable)
- U-Boot can have Secure Variables **and** OP-TEE running simultaneously



Development - Micro BMC

The STM32F042 microcontroller used for the Micro BMC is typically cheaper in large quantities than an FTDI FT230X and can provide us with more features.

It "just needs software" to be able manage power/reset, UART, I2C and SPINOR (perhaps also JTAG).

Let's make a firmware for it:

https://github.com/daniel-thompson/tiny-manager

Currently this firmware can only poke the power/reset lines but if we add UART then we can start chasing 96Boards CE 2.0 design wins as the USB-to-UART bridge.



Thank you

Accelerating deployment in the Arm Ecosystem

