Die wirre Welt der kleinen Computer

Daniel Maslowski

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Agenda

- Introduction
- Understanding hardware
- Looking at the SoC
- Tracking upstream
- Cool projects
- Finding a community

Introduction

So many options…

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People often look at computers and ask:

Does/can it run “Linux”?

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People often look at computers and ask:
Does/can it run “Linux”?

That is a very tough question. Let’s see! :-)

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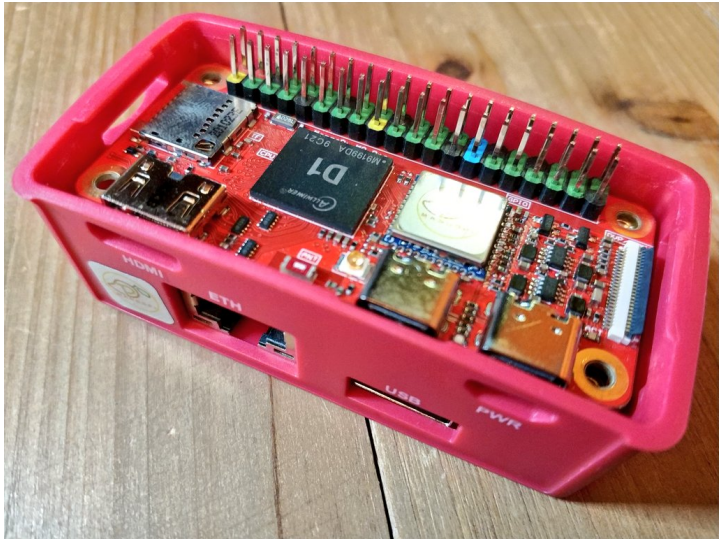
Compatibility



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Confusion

wiki.radxa.com/zero/downloads

Official ROCK Pi system images can also be downloaded from **ROCK Pi BaiduPan** or **Radxa Github Release**.

For user names and passwords please check the FAQ.

Tools

Description	Linux	MacOS
Etcher - A user friendly Image Writer	Linux 64bit | Linux 32bit	balenaEtcher-1.5.76.dmg

Official Images

	**Android 9**	**Android Install Wiki.**
	Ubuntu Focal	**Ubuntu Product. Install Wiki. Ubuntu Focal (20.04).**
	Debian Buster	**Debian Product. Install Wiki. Debian Buster(10).**

Third Party Images

	openSUSE Tumbleweed JeOS	**Build 2022-07-04.** **Install WiKi** **user:root password:linux**

Peripherals

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Drivers and special component firmware can be very nasty.

- graphics / GPU
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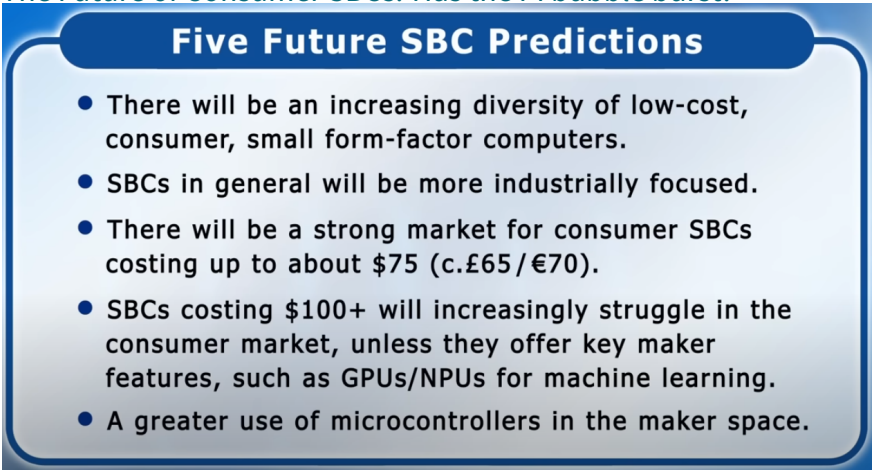
Fun story:

We had to install `bluez-firmware` to get Wi-Fi working on a Radxa Zero.

Prediction

The Future of Consumer SBCs: Has the Pi bubble burst?



https://www.youtube.com/watch?v=Hjb3bx6vxnc

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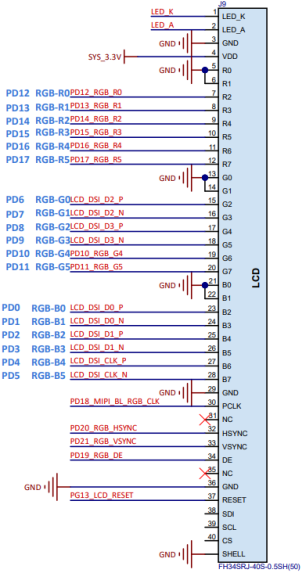
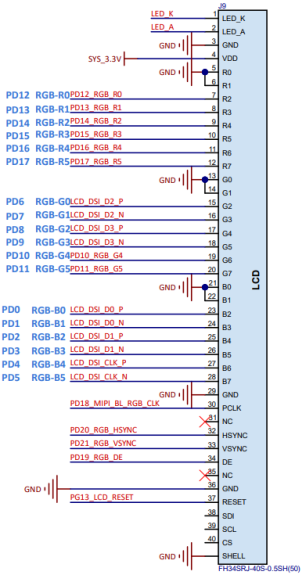
Understanding hardware

Reading Schematics



Reading Schematics



Why does my LCD not work?

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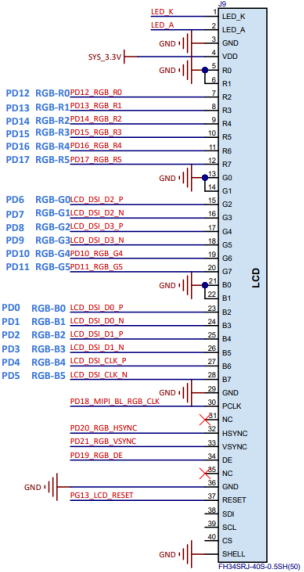
Reading Schematics

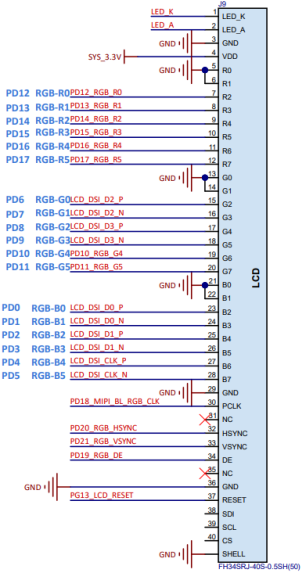


Why does my LCD not work?

Look very, very closely at the interface…

No.	Symbol	Description
1	VBL-	Backlight LED Cathode
2	VBL+	Backlight LED Anode.
3	GND	System Ground
4	VCC	Power supply for logic operation
5~12	R0~R7	Data bus
13~20	G0~G7	Data bus
21~28	B0~B7	Data bus
29	GND	System Ground
30	CLK	Pixel clock signal
31	DISP	Display on/off control
32	HSYNC	Horizontal Sync signal
33	VSYNC	Vertical Sync signal
34	DEN	Data Enable
35	NC	No connect
36	GND	System Ground
37	NC/XR	TP pin XR
38	NC/YD	TP pin YD
39	NC/XL	TP pin XL
40	NC/YU	TP pin YU

Reading Schematics



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Aha, Pin 31 enables the display.
But it’s not connected on my board.
Let’s fix it! :-)

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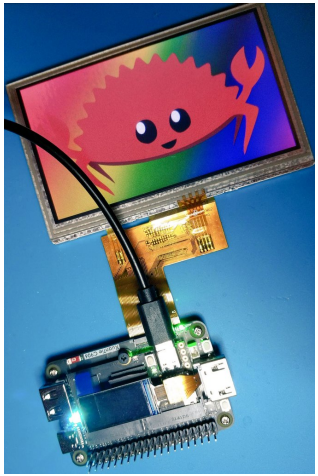
Hardware Hacks



https://github.com/adamgreig/d1rgb

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TRM / SoC manual / datasheets

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To understand a chip, you need its *Technical Reference Manual (TRM)*.

It may also be called *SoC (System on Chip) manual* or just *datasheet*.

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Manuals are rarely public, often contain “confidentiality” notes.

They may have errata and/or be incomplete.

A Primer on Embedded Linux

So you want to build an embedded Linux system?

> *The first step is to architect your system. This is hard to do unless what you're building is trivial or you have a lot of experience, so you'll probably start by buying some reference hardware, trying it out to see if it can do what you're trying to do (both in terms of hardware and software), and then using that as a jumping-off point for your own designs.*

https://jaycarlson.net/embedded-linux/

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Looking at the SoC

Capabilities

Not every SoC is general purpose.

Many SoCs are designed for narrow tasks, yet *seem* generic.

Common FruitPi SoC Vendors

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OrangePi, BananaPi, CherryPi, MangoPi, … you get the idea.

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Loader Tools

`sunxi-fel` / `xfel`

`rkflashtool`

`pyamlboot`

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Note: These compete on the multimedia device market, e.g., TV boxes.

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`pyamlboot`

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https://linux-sunxi.org/Comparison_of_chip_maker_openness

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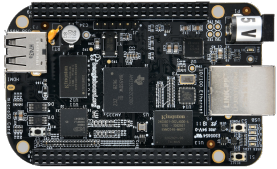
More SoC vendors

TEXAS INSTRUMENTS

AM{3,4,5,6}xx series
used in Beaglebone Black



NXP

i.MX application processors
used in MNT Reform laptop

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Even more SoC vendors

Tracking upstream

Firmware

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Firmware

a boot loader for
Embedded boards

https://u-boot.readthedocs.io/

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a fork of coreboot, with
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Linux

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Linux

Protocol	Location
HTTP	https://www.kernel.org/pub/
GIT	https://git.kernel.org/
RSYNC	rsync://rsync.kernel.org/pub/

Latest Release
6.4

mainline:	**6.4**	2023-06-25	[tarball] [pgp] [patch]	[view diff]	[browse]	
stable:	**6.3.10**	2023-06-28	[tarball] [pgp] [patch] [inc. patch]	[view diff]	[browse]	[changelog]
longterm:	**6.1.36**	2023-06-28	[tarball] [pgp] [patch] [inc. patch]	[view diff]	[browse]	[changelog]
longterm:	**5.15.119**	2023-06-28	[tarball] [pgp] [patch] [inc. patch]	[view diff]	[browse]	[changelog]
longterm:	**5.10.186**	2023-06-28	[tarball] [pgp] [patch] [inc. patch]	[view diff]	[browse]	[changelog]
longterm:	**5.4.249**	2023-06-28	[tarball] [pgp] [patch] [inc. patch]	[view diff]	[browse]	[changelog]
longterm:	**4.19.288**	2023-06-28	[tarball] [pgp] [patch] [inc. patch]	[view diff]	[browse]	[changelog]
longterm:	**4.14.320**	2023-06-28	[tarball] [pgp] [patch] [inc. patch]	[view diff]	[browse]	[changelog]
linux-next:	**next-20230629**	2023-06-29			[browse]	

https://kernel.org

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Specialized distros for Arm

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Arch Linux Arm

https://archlinuxarm.org/

openSUSE

https://en.opensuse.org/Portal:Arm

Fedora

https://fedoraproject.org/wiki/Architectures/ARM

Armbian

https://www.armbian.com/

Ubuntu

https://ubuntu.com/download/server/arm

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Armbian

https://www.armbian.com/

Ubuntu

https://ubuntu.com/download/server/arm

Problem: Many of these have specific images per board.
Why? (many reasons)

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Cool projects

Does it have to be…

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Does it have to be…

… a general purpose distro?

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- Yocto/OpenEmbedded
- Buildroot
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In general, they are more open.

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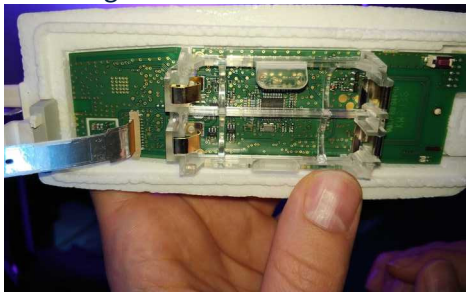
In general, they are more open.
You can get one for free: Wettersonde



https://github.com/arnobert/rs41_rust

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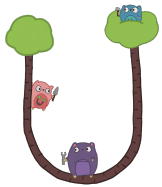
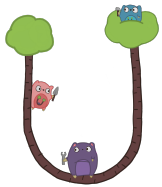
u-root



an initramfs builder with Busybox-like tools written in Go

https://u-root.org

u-root



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`cpu`

cpu command in Go, inspired by the Plan 9 cpu command

https://github.com/u-root/cpu

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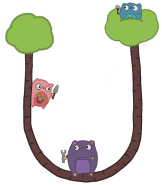

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How about USB CPU? Demo time!

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Gokrazy

what if we massively reduced the overall system complexity by getting rid of all software we don't strictly need, and instead built up a minimal system from scratch entirely in Go

https://gokrazy.org/

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Build Go appliances for the Raspberry Pi using gokrazy!

https://media.ccc.de/v/gpn21-78-build-go-appliances-for-the-raspberry-pi-using-gokrazy-

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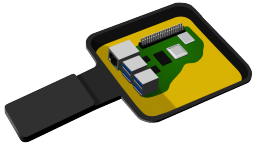
Racklet



Racklet is a fully-integrated, miniature server rack.

https://racklet.io/

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Finding a community

Communication channels

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In person

Have you visited your local fablab, hackerspace or makerspace yet?

Thank you! :)

Related

Repurposing Gadgets (FOSSASIA Summit 2021)

https://metaspora.org/repurposing-gadgets-fossasia2021.pdf

Drivers from Outer Space (CLT 2022)

https://chemnitzer.linux-tage.de/2022/en/programm/beitrag/226

Speedy Distro Porting via the cpu Command

https://media.ccc.de/v/3802-speedy-distro-porting-via-the-cpu-command

Platform System Interface - Design und Evaluation holistischer Computerarchitektur (rC3 2022)

https://media.ccc.de/v/fire-shonks-2022-49154-platform-system-interface-design-und-evaluation-holistischer-computerarchitektur

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https://metaspora.org/sbcs-and-socs-tuebix-2023.pdf

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