

Slides: <https://github.com/pdp7/talks/blob/master/oshw-36c3.pdf>

Intro to Open Source Hardware, OSHWA & Open Hardware Summit

Chaos Communication Congress (36c3) – CDC stage

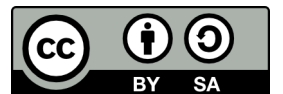
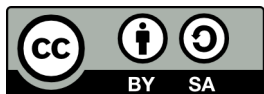


Drew Fustini

OSH Park

drew@oshpark.com

[@oshpark](#) / [@pdp7](#)



- Open Source Hardware designer at OSH Park
 - PCB manufacturing service in the USA
 - drew@oshpark.com / Twitter: [@oshpark](https://twitter.com/oshpark)
- Volunteer Member of Board of Directors of BeagleBoard.org Foundation
 - **drew@beagleboard.org**
- Volunteer Member of the Board of Directors of the Open Source Hardware Association (OSHWA)
 - serving as Vice President
 - **drew@pdp7.com**



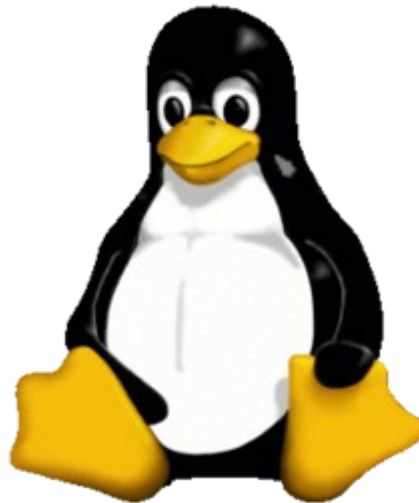
What is Open Source?



- Examples of popular Open Source projects



Apache



LibreOffice[®]



Firefox[®]



What is Open Source?



- The term "**open source**" refers to something people can **modify and share** because its design is **publicly accessible**
- **Open Source software** is software with source code that anyone can:
inspect, modify, and enhance



What is Free Software?



A program is free software if the users have **four essential freedoms**:

- 1) run the program as you wish, for any purpose
- 2) study how the program works, and change it so it does your computing as you wish
- 3) redistribute copies so you can help your neighbor
- 4) distribute copies of your modified versions



Open Source Hardware



- **FLOSS** is a term to describe software that is **Free**, **Libre**, or **Open Source Software**
- In the context of hardware projects, I consider these terms equivalent:
 - Free Hardware
 - Libre Hardware
 - Open Hardware
 - Open Source Hardware

Open Source Hardware

Statement of Principles:

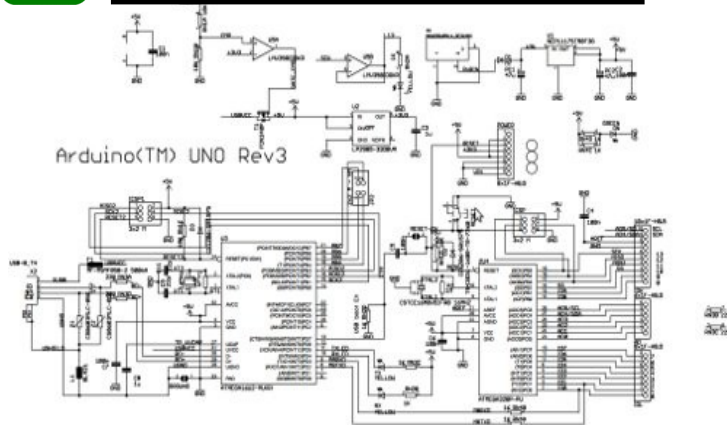
Hardware whose **design** is made **publicly available** so that anyone can **study**, **modify**, **distribute**, **make**, and **sell** the design or hardware based on that design

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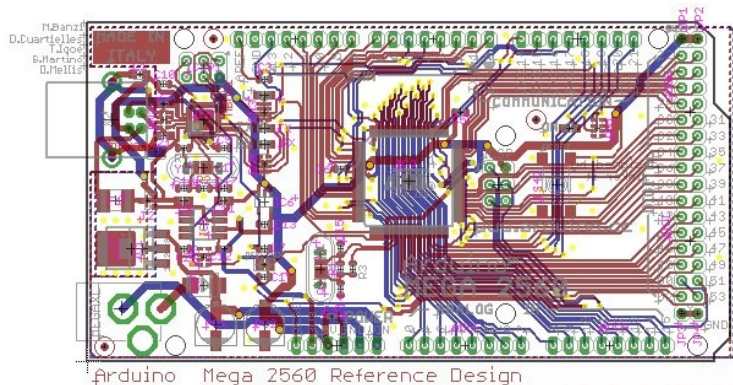
Open Source Hardware

Documentation required for electronics:

✓ **Schematics**



✓ **Board Layout**



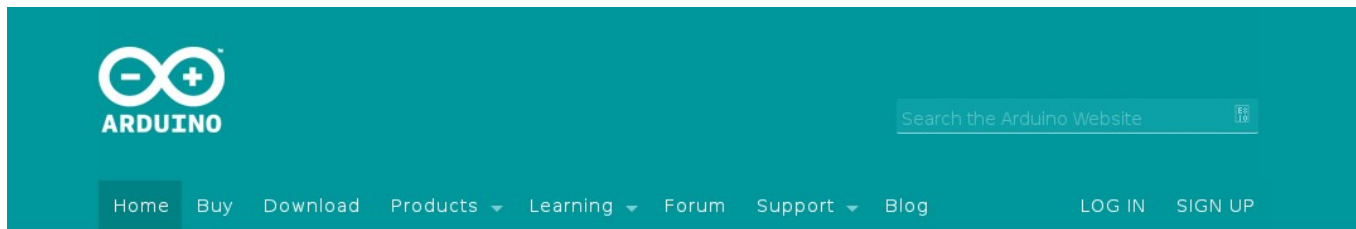
Editable source files for CAD software such as KiCad or EAGLE

✓ **Bill of Materials (*BoM*)**

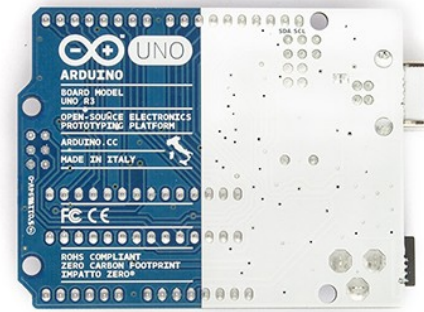
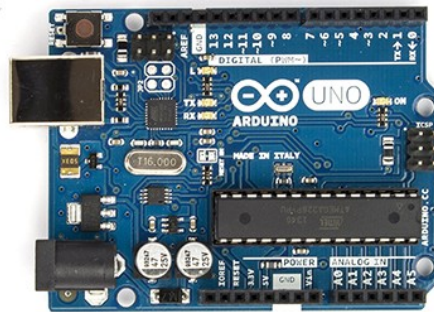
Best practice: all components available from distributors in **low quantity**

Open Source Hardware

Example: **Arduino** achieved **critical mass** by **sharing** their hardware designs and source code



Arduino Uno



[Arduino: The Documentary](#) describes the team's motivation



Open Source Hardware



- ✓ Example: [Arduino Uno](#) schematic and PCB layout design files for EAGLE CAD can be downloaded from [Arduino.cc](#)

The screenshot shows a web browser window with the URL <https://www.arduino.cc/en/Main/ArduinoBoardUno>. The page features a teal navigation bar with links: Buy, Software, Products, Learning, Forum, Support, and Blog. The main content area is titled "Documentation" in orange. On the left, a sidebar lists: Overview, Get Inspired, Related Items, Technical Specs, and Documentation (which is highlighted). The main text reads: "OSH: Schematics, Reference Design, Board size" and "Arduino / Genuino Uno is open-source hardware! You can build your own board using the following files:". Below this, there are two download buttons: a yellow one for "EAGLE FILES IN .ZIP" with the Eagle logo, and a brown one for "SCHEMATICS IN .PDF" with a schematic symbol.

Arduino - ArduinoBoa... x +

https://www.arduino.cc/en/Main/ArduinoBoardUno

Search

Buy Software Products Learning Forum Support Blog

Documentation

Overview

Get Inspired

Related Items

Technical Specs

Documentation

OSH: Schematics, Reference Design, Board size

Arduino / Genuino Uno is open-source hardware! You can build your own board using the following files:

 EAGLE FILES
IN .ZIP

 SCHEMATICS
IN .PDF



Open Source Hardware



Publish documentation with an
Open Source license:

- Creative Commons Share-Alike: **CC-BY-SA**
 - [Non-Commercial \(NC\) clause is NOT acceptable](#)
- Copyleft: **GPLv2, GPLv3**
- Permissive: **Apache, BSD, MIT**
- OSHW inspired: **CERN OHL, TAPR, SolderPad**



CERN Open Hardware Licence

- Originally written for **CERN** designs hosted in the **Open Hardware Repository**
- Can be used by **any designer** wishing to **share design** information using a **license compliant** with the **OSHW definition criteria**.
- [CERN OHL version 1.2](#)
Contains the license itself and a guide to its usage



CERN Open Hardware Licence



- Video interview with [Javier Serrano](#)
- physicist and electronics engineer at CERN
- co-author of the **CERN Open Hardware License**
- creator of the **Open Hardware Repository**



Open Source Hardware



**Licenses, Copyright and Patents
can get confusing!**

Review of Popular OSHW Licenses

Video of Ari Douglas at OHS 2014

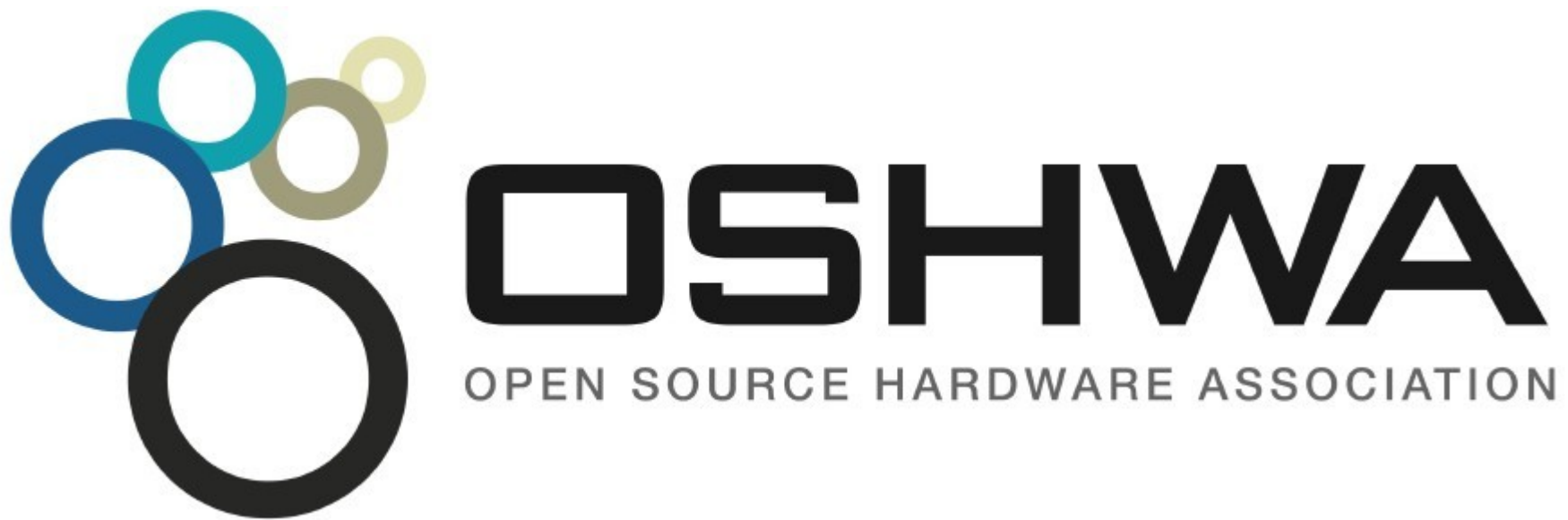


Open Source Hardware

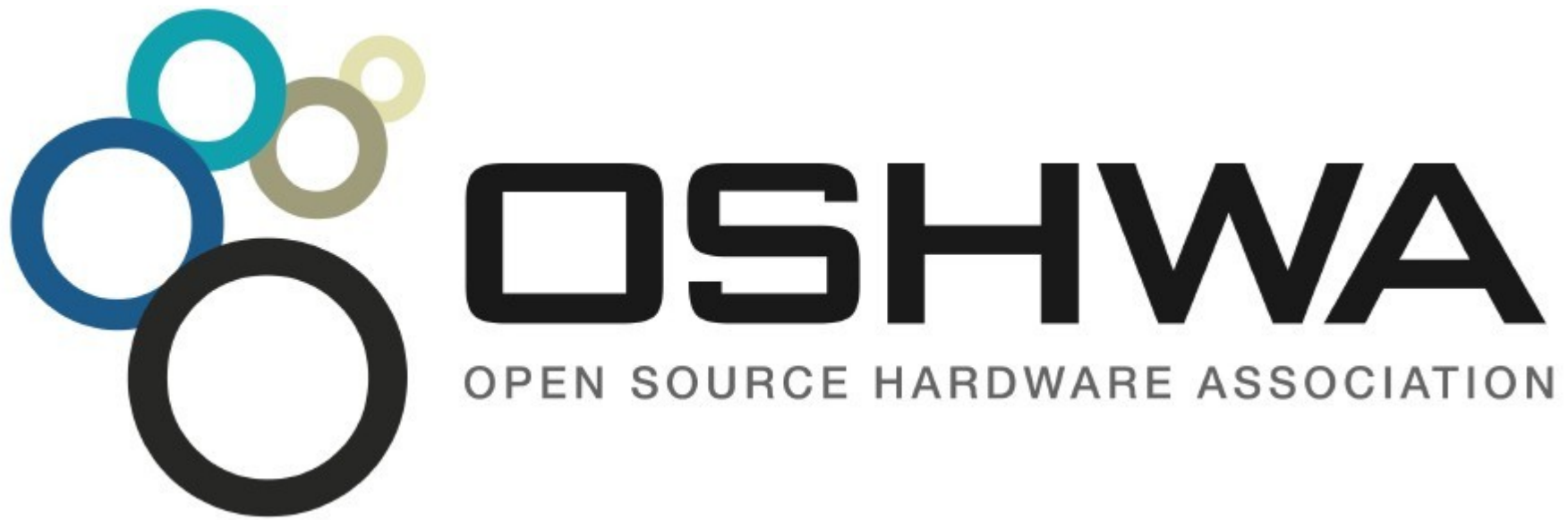


What is the spirit of Open Source?

- Publish everything that will:
enable collaborative development
- Goal is NOT to check a box on a marketing brochure or add keywords to a crowdfunding campaign



- US-based *501(c)3* non-profit organization
- Hosts the [Open Source Hardware definition](#)
- “aims to be the **voice of the open hardware community**, ensuring that technological knowledge is accessible to everyone, and encouraging the collaborative development of technology”



- [OSHW Best Practices](#)
- [Quick Reference Guide](#)
- [OSHW "May and Must" \(PDF\)](#)
- [OSHW Checklist \(PDF\)](#)

Open Hardware Summit (OHS)

- OHS 2020: March 13 in NYC (USA)
 - <http://2020.oshwa.org/>
- *8 prior summits:*
 - **2010, 2011:** New York Hall of Science
 - **2012:** Eyebeam (*NYC*)
 - **2013:** MIT (*Boston area*)
 - **2014:** Roma, Italia!
 - **2015:** Philadelphia, USA
 - **2016:** Portland, Oregon, USA
 - **2017:** Denver, USA
 - **2018:** MIT (Cambridge, MA, USA)

October is Open Hardware Month!



- People all over the world celebrated with meet-ups, talks and workshops
- Kicked off with events at RAIT in Vienna (Austria) and SparkFun in Colorado (USA), followed by gatherings in Poland, Panama, Thailand, Japan, Ghana and more!
- 40 events in 14 different countries across 5 continents

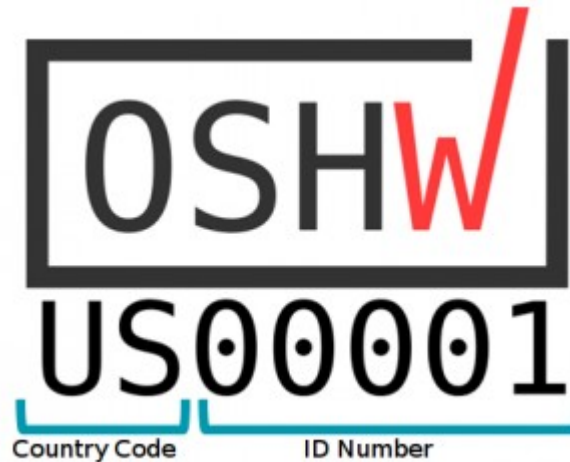
Open Hardware Summit (OHS)

- The Open Hardware Summit 2018 talks are available as individual videos on YouTube

The screenshot shows the YouTube channel page for the Open Hardware Summit 2018. The navigation bar includes links for HOME, VIDEOS (selected), PLAYLISTS, CHANNELS, DISCUSSION, and ABOUT. Below the navigation bar, there are filters for 'Uploads' and 'PLAY ALL', and a 'SORT BY' dropdown menu. The main content area displays a grid of 15 video thumbnails, each with a title, a duration, and a view count. The videos are arranged in three rows of five.

Video Title	Duration	Views	Time Ago
Alicia Gibb: Closing Remarks (19 of 19)	7:55	1 view	22 hours ago
Adam Benzion: How to build a huge open source...	20:07	No views	22 hours ago
Amitabh Shrivastava: Programmable Air (17 of 19)	11:12	2 views	22 hours ago
Drew Fustini: OHS Badge Overview (6 of 19)	5:13	7 views	22 hours ago
Joseph Apuzzo: MicroPython on ESP32 and LoBo (12 of...	24:05	3 views	22 hours ago
Neil Gershenfeld: How To Make almost Anything (11 o...	35:20	No views	22 hours ago
Surya Mattu: Approaching adversarial research (3 of 19)	16:33	No views	22 hours ago
Evan Raskob: Livecoding 3D printing: experiments in live...	17:51	No views	22 hours ago
Robin Getz: Open Source Software Defined Radio (7 o...	18:17	No views	22 hours ago
Eric Von Hippel: Economics of Open Hardware (2 of 19)	22:50	2 views	22 hours ago
Mario Gómez : Building Resilience With Public...	8:37	No views	22 hours ago
Stephanie Valencia: Creating a more accessible future wi...	13:21	No views	22 hours ago
Tarek Loubani: Gaza tournament: Making lifesavin...	21:54	1 view	22 hours ago
Ted Hayes: How to Put A Neural Network on an...	20:14	4 views	22 hours ago
Michael Weinberg: Open Source Hardware...	13:32	3 views	22 hours ago

Open Source Hardware Certification Program



- Allows hardware that complies with the community definition of Open Source Hardware to display a [certified OSHw logo](#)
- Make it easier for users of OSHw to track down documentation and information
- *More information:* certificate.oshwa.org

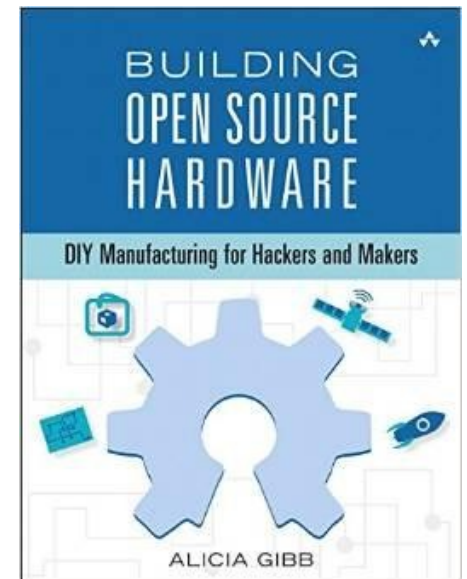


Open Source Hardware



Resources

- Join OSHWA
- Subscribe to the mailing list
- Post in the OSHWA Forum
- Follow on Twitter:
 - @OHSummit
 - @oshwassociation
- [Building Open Source Hardware](#)
by Alicia Gibb (*executive director of OSHWA*)



Open Source Hardware

Bonus section:
LINUX on OSHW
(my two favorite things!)

Novena laptop

- Created by Bunnie Huang & Sean Cross (xobs)
 - Chumby, “Hacking the Xbox”, [amazing reverse engineers](#)
- 100% Open Source Hardware laptop
- Quad-core 1.2GHz ARM, 4GB RAM, SSD, WiFi
- Xilinx FPGA for custom hardware design
- Software Defined Radio (SDR) module



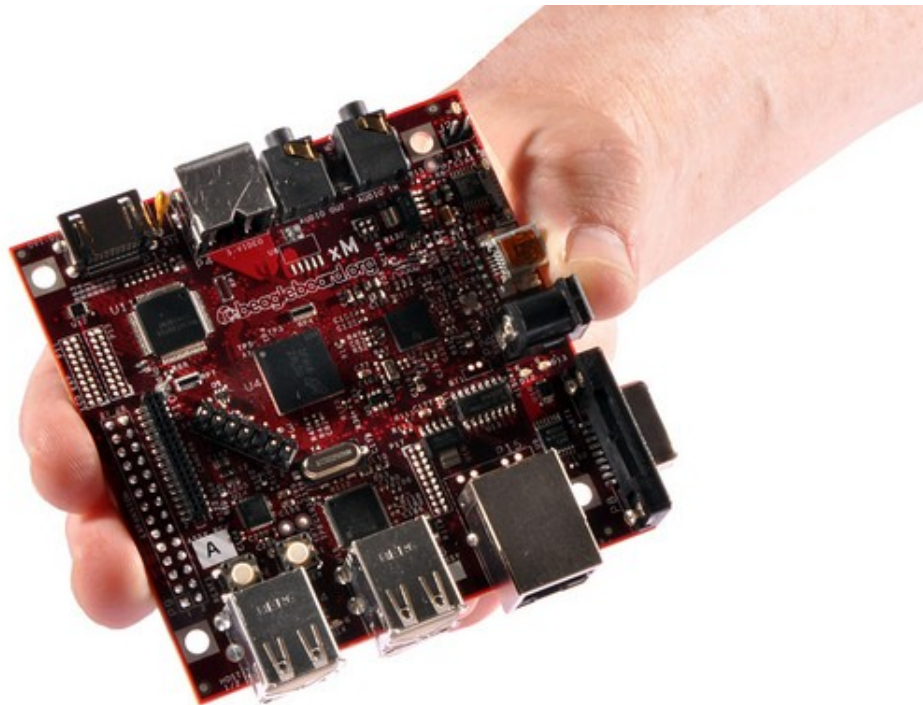


- Open Source Hardware computing for Makers, Educators & Professionals
- Developed by [BeagleBoard.org Foundation](#) and [BeagleBoard.org Community](#)
- [Manufacturers: element14, GHI, Seeed](#)



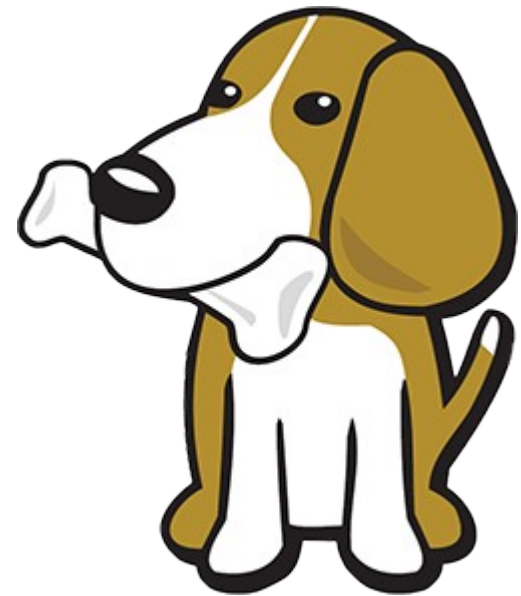


BeagleBoard.org released the first **BeagleBoard**, an affordable, open hardware ARM computer in **2008**





Maker focused, Altoids tin sized
BeagleBone introduced in **2011**





More affordable, more powerful
BeagleBone Black in 2013





Open Source Hardware BeagleBone derivatives

	Capes	HDMI	Flash	Special
BeagleBoard.org BeagleBone	Y	N	N	JTAG
BeagleBoard.org BeagleBone Black	Y	Y	Y	-
Arrow BeagleBone Black Industrial	Y	Y	Y	Industrial
Element14 BeagleBone Black Industrial	Y	Y	Y	Industrial
SeeedStudio BeagleBone Green	Y	N	Y	Grove
SanCloud BeagleBone Enhanced	Y	Y	Y	1GB, 1Gbit, wireless
BeagleBoard.org BeagleBone Blue	N	N	Y	Robotics
BeagleBoard.org BeagleBoard-X15	N	Y	N	Big jump in CPUs and I/O

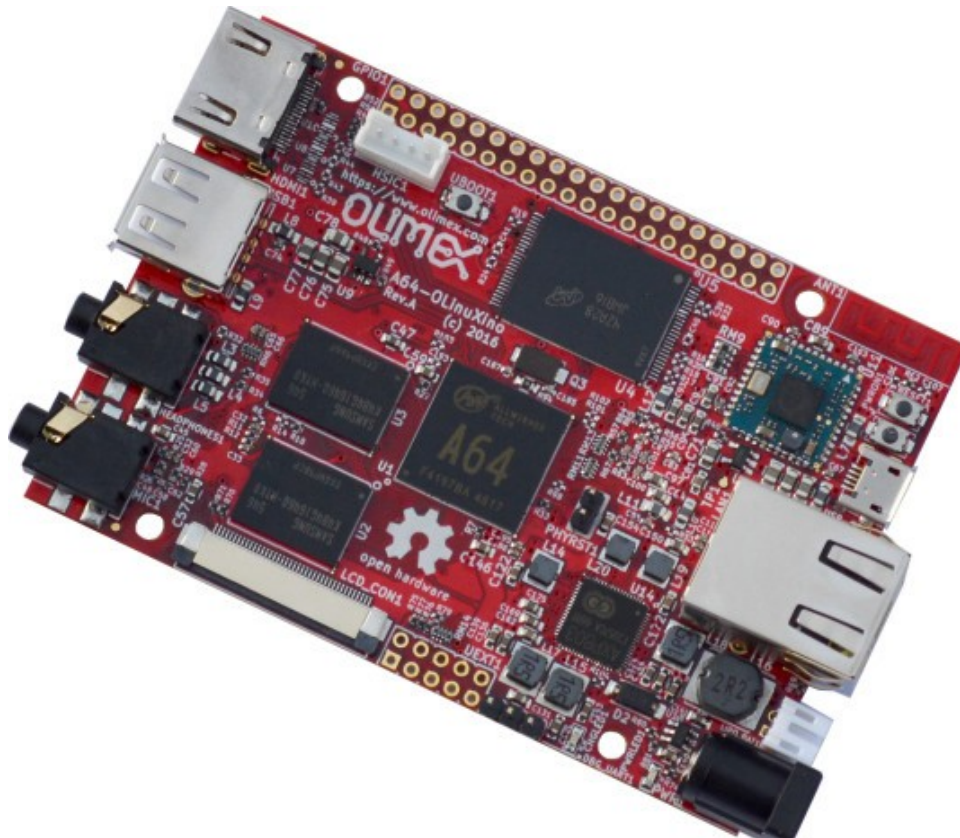


OLinuXino



- Low cost OSHW Linux computers
- Designed and manufactured by **Olimex** in **Bulgaria**
- Great blog post:
[Open Source Hardware, why it matters and what is pseudo OSHW](#)

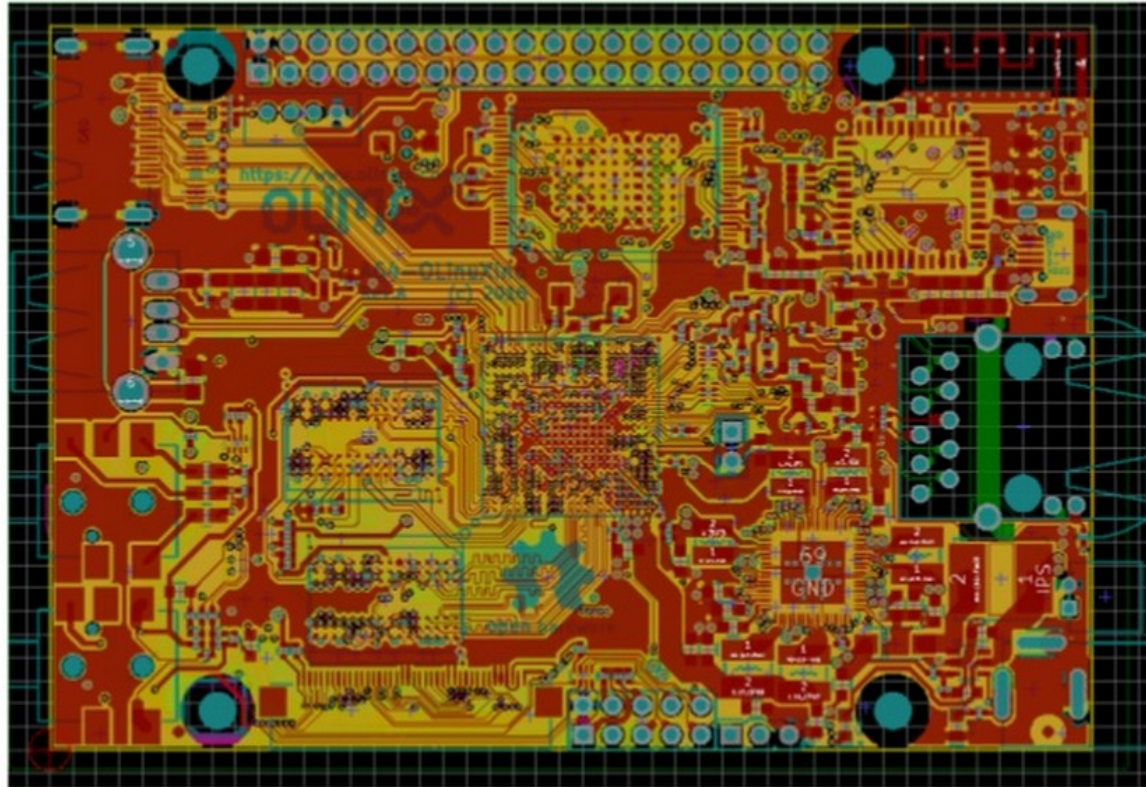
- Allwinner A64: Quad Core **64-bit ARM**
- Designed with Open Source **KiCad**
- 1GB RAM, 4GB eMMC, WiFi+BLE4.0





Using FOSS tools for OSHW project

Designing with KiCAD of 64-bit ARM board



Tsvetan Usunov, OLIMEX Ltd

FOSDEM 2016

[Slides](#) / [Video](#)



- **KiCad** is an Open Source EDA suite including Schematic Capture and PCB Layout
- Cross platform: **Windows, Mac OS** and **Linux**
- **CERN has contributed** professional CAD features for high-speed digital design
- Learn to design your own PCB in KiCad with: [Getting to Blinky](#)



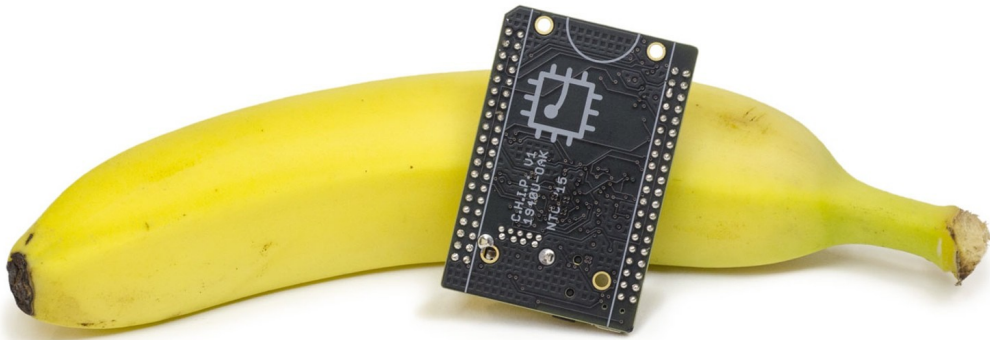
TERES I Laptop



- “DIY Open Source Hardware Software Hacker's friendly Modular Laptop”
- [Developing an Open Source Laptop](#) talk by Olimex founder Tsvetan Usunov at Hackaday Belgrade
- [Design files on GitHub](#):
“everyone can download & learn, study, edit, modify”



CHIP



The World's First \$9 Computer

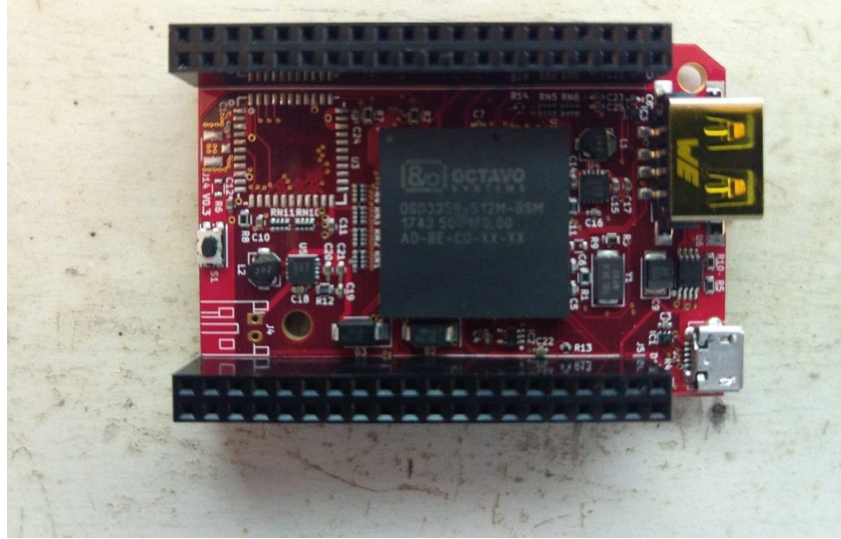
- getchip.com
- Next Thing Co. in Oakland
- Kickstarter in 2015
- [Company ended in 2018](#)



C.H.I.P. is OSHW



- **GitHub:** [NextThingCo/CHIP-Hardware](#)
 - Schematics
 - PCB Layout
 - Bill of Materials (*BoM*)
- **License:**
 - Creative Commons Attribution-ShareAlike (*CC-BY-SA*)



- Nebula One created by Groguard to be compat
- PocketChip with Nebula One running DOOM!



Groguard
@groguard

Follow



Doom running on the NebulaOne board in the PocketCHIP. Wifi and LCD are working! Just need get the keyboard sorted next! @pdp7
@Jadon @dcschelt



Giant Board by groguard

- A single-board computer in the Adafruit Feather form factor
- Funded on Crowd Supply

CROWD SUPPLY

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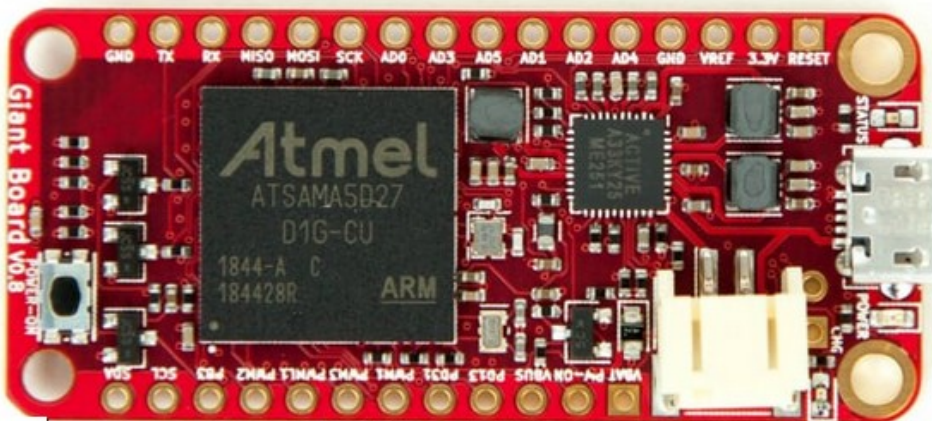
Giant Board

by Groboards

Open Hardware
Computers & Networking
Development Kits

A single-board computer in the Adafruit Feather form factor

Part of
Microchip Get Launched
2019



\$13,670 raised
of \$12,250 goal

111% Funded!

Order Below

8
updates

Aug 08
funded on

162
backers

Last update posted Aug 07, 2019

me@example.com

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Open Source and FPGAs

- Open Source toolchains for FPGAs!
 - Project IceStorm for Lattice iCE40
 - Project Trellis for Lattice ECP5
- Open Source Hardware boards with Lattice ECP5 FPGA with open RISC-V “soft” CPU:
 - [Orange Crab by Greg Davill](#)
 - [Radiona.org ULX3S](#)
 - [David Shah's Trellis board \(Ultimate ECP5 Board\)](#)
 - [MyStorm with ECP5 by Alan](#)



Tweet

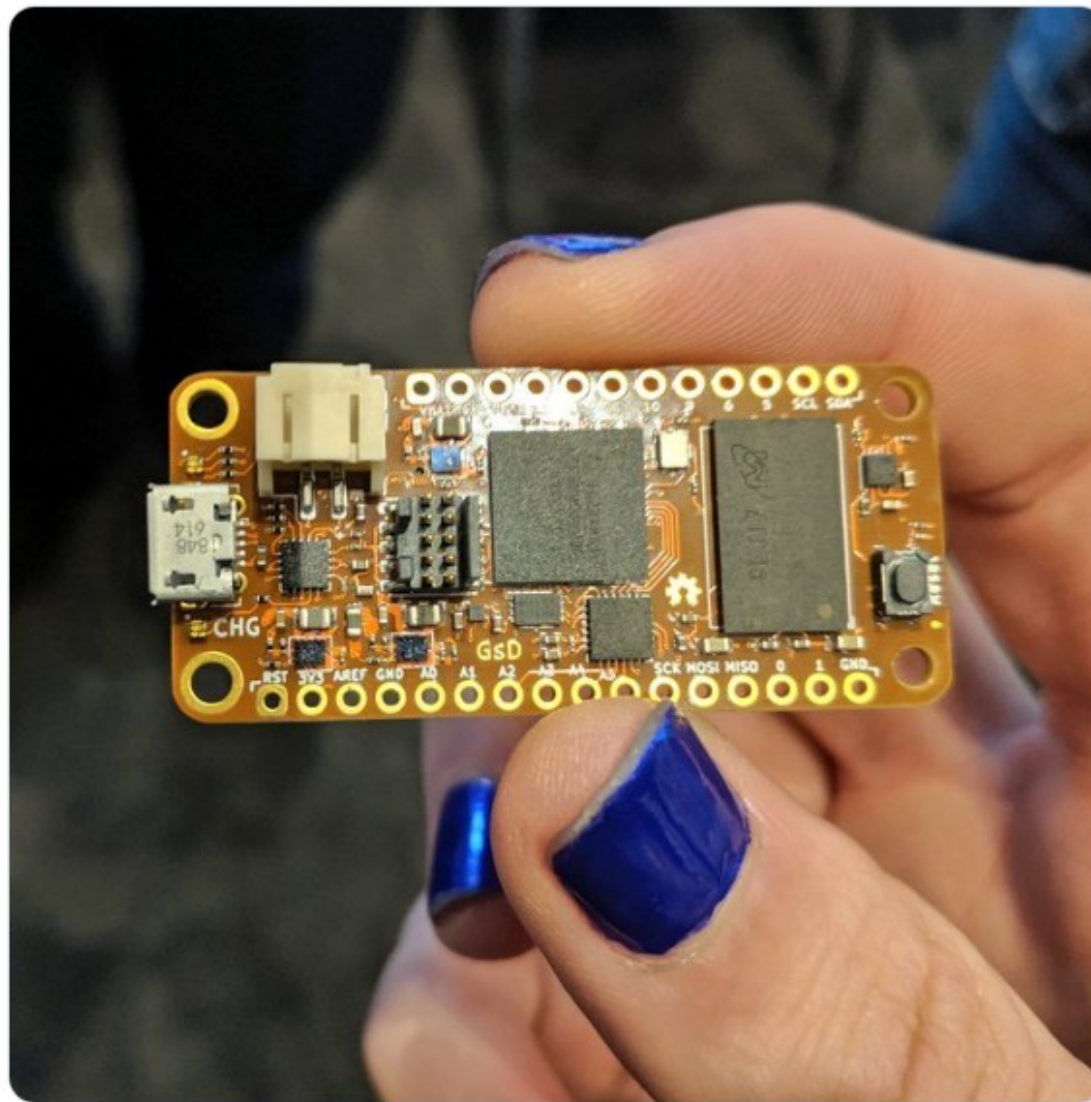


Drew Fustini

@pdp7

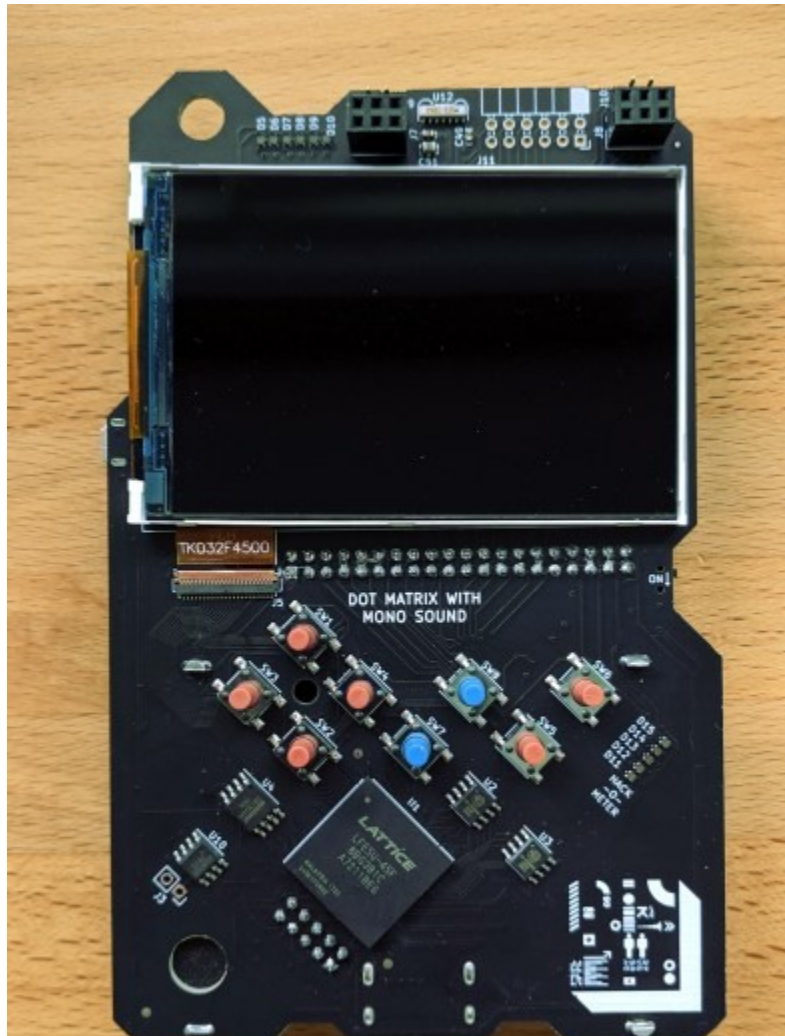


Awesome to see the Orange Crab ECP5 FPGA board by [@GregDavill](#) in Lyon thanks to [@antonblanchard](#)! 🍊
🦀



Hackaday 2019 Supercon badge

- RISC-V “soft” core on ECP5 FPGA
- Gigantic FPGA In A Game Boy Form Factor



Slides:

github.com/pdp7/talks/blob/master/oshw-36c3.pdf

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