Open Hardware at CERN

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## Outline

1. Introduction to Open Hardware
2. The Open Hardware Repository
3. Legal Aspects
4. Economics
5. FOSS for Open Hardware
6. Conclusions
There is an OSHW definition!

Check out http://www.oshwa.org/definition/

- Inspired by the Open Source definition for software.
- Focuses on ensuring freedom to study, modify, distribute, make and sell designs or hardware based on those designs.
- Now we know exactly what we mean when we say OSHW!
## Dispelling the commercial vs open myth

<table>
<thead>
<tr>
<th>Open</th>
<th>Commercial</th>
<th>Non-commercial</th>
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<tbody>
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<td></td>
<td>Winning combination. Best of both worlds.</td>
<td>Whole support burden falls on developers. Not scalable.</td>
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<td>Proprietary</td>
<td>Vendor lock-in.</td>
<td>Dedicated non-reusable projects.</td>
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Why we use Open Hardware 1/2

Get a design just the way we want it
We specify fully the design.

Peer review
Get your design reviewed by experts all around the world, including companies!

Design re-use
When it’s Open, people are more likely to re-use it.

Healthier relationship with companies
No vendor-locked situations. Companies selected solely on the basis of technical excellence, good support and price.
Dissemination of Knowledge
One of CERN’s key missions!

Spend money where you or your funding agencies want
- Makes life easier for public institutions
- Opens the door to smaller companies with good local support
Open Hardware Repository – ohwr.org

A web-based collaborative tool for electronics designers
- Wiki, News
- File repository
- Issues management
- Mailing list

Fully open access
- All information readable by everyone, without registration

Platform made itself of open software
- ChiliProject (a fork of Redmine)
- SVN/GIT for version management, integrated in OHR
- Sympa mailing list manager
Example of an OHR project

FMC PROJECTS » SIMPLE PCIE FMC CARRIER (SPEC)

OVERVIEW

A simple 4-lane PCIe carrier for FPGA Mezzanine Cards (VITA 57). It has memory and clocking resources and supports the White Rabbit timing and control network.

- Detailed project information
- Subprojects: Software support for the SPEC board
- Status: Beta
- Licence: CERN OHL
OHR Current Status

Projects
- 123 projects
  - 70 initiated by CERN groups, 53 by other institutes
- 165 active developers, many more users

Types of designs
- Around 60 hardware designs
- Around 20 re-usable HDL cores
- General tools like
  - Production test environment (Python based)
  - ADC performance test

Designs are fully documented: OHR is a great place to learn electronics!
FMC mezzanine: 100 MSPS 14-bit 4-channel ADC
CERN Open Hardware License – ohwr.org/cernohl

Provides a solid legal basis

- Developed by Knowledge Transfer Group at CERN.
- Better suited than non-HW licenses (GPL, Creative Commons...)
- Defines conditions for using and modifying licensed material.

Provides a clear legal environment

- Written in a clear, concise style.
- Easy for licensors to evaluate if this is good for them.
Inspired by FOSS licenses

- Anyone can see the source (design documentation).
- Anyone is free to study, modify, manufacture and share.
- Any modification and distribution must happen under same license.
- Persistence makes everyone profit from improvements.

Takes into account hardware production and distribution

- When producing and distributing licensee is invited to inform the licensor.
- Distributed HW must come with documentation.
CERN OHL is itself an Open project

Web-based remote collaboration
- Many experts and enthusiasts from around the world.
- Hosted in ohwr.org/cernohl.
- Most communication done through a mailing list with public archives.

Evolving
- Version 1.2, just released, helps guarantee that recipients of OSHW get access to the design files.
- Efforts start now to make a new version which will handle Hardware Description Language (HDL) based designs appropriately.
Example of mechanics licensed with the CERN OHL

Worm farm and rotocaster
Some key ideas 1/2

It’s about Free as in “Freedom”
- People need to make a living!
- Most successful FOSS projects have paid developers.
- Companies help ensure projects are not based on unpaid work (good for scalability).

We live in a world of creative abundance
- Some business models are incompatible with OSHW. So be it.
- Find a good company that suits your needs without compromising openness.
- Buy design, hardware and support. Vote for openness with your wallet.
Some key ideas 2/2

**OSHW forces you to design better**
- Other people will commercialize what you design.
- Lots of documentation needed.
- Testing gear and (automated) procedure is a must.
- Using standards is very important.

**When in doubt, look at FOSS!**
- Software people have worked many things out through the years.
- Most of the arguments, business models, etc. apply directly to OSHW.
Experience with Industry

Companies

- 15 European, 1 US.
- 60 projects.

Types of work

- Hardware: PCB development, production, HDL development.
- Software: device drivers.
- Usually small projects (<2 months work), speeds up projects, gets in specialist knowledge.
- Small firms can play a large role.
Experience with Industry

Examples of re-use of work

- Two companies modified SPEC carrier design.
  - larger FPGA (for software radio DSP).
  - PXIe bus instead of PCIe.
- A company re-uses White Rabbit spec for own product.
- Another one used nanoFIP VHDL for renovating trains.

Generates interaction

- One company helps another with product development.
- Firms work together in mutualistic symbiosis:
  - One sells a carrier, others sell mezzanines.
  - One sells a WR switch, others sell WR nodes.
HDL simulation flow 1/2: HDL entry
HDL simulation flow 2/2: HDL simulator
PCB design flow 1/5: schematics entry
PCB design flow 2/5: PCB layout
PCB design flow 3/5: artwork
PCB design flow 4/5: drilling
PCB design flow 5/5: pick and place
Try to use FOSS tools for development

Tools: the last hurdle to sharing

- We already have a forge and a license.
- Current proprietary CAD tools make it hard to share designs.

Current efforts

- Icarus Verilog: help in adding VHDL and SystemVerilog support.
- Your help is very welcome!
Regarding public research institutions

**OSHW is good for the labs**
- Develop technology, avoid maintenance burden
- Reduce development costs and avoid vendor lock-in
- Return benefits to society
  - Feed into local and global economy
  - Make results quickly available
  - Communicate results widely to citizenship

**OSHW is good for the companies**
- Further develop and support technology, making a profit
- Negligible upfront costs, easy entry into market
Why we use Open Hardware

Does it hold its promises?

Get a design just the way we want it – Yes
With own designers and with outside help (industry, institutes).

Peer review – Yes
From different groups. Also by industry.

Design re-use – Yes
- SPEC and ADC100M have users and lots of interest.
- SPEC design is being copied and re-used in other designs.

Healthier relationship with companies – Yes
- We are much more free to work with small companies.
- Not tied to any single one.
Why we use Open Hardware
Does it hold its promises?

**Dissemination of knowledge – Yes**
Lots of interaction with other institutes, universities and companies, much more than before.

**Spend money where you or your funding agencies want – Yes**
Many projects spread among CERN member states.
Conclusions

- The electronics that we support cannot be black boxes.
- Open Hardware has many advantages.
  - Anyone can help in developments and make improvements.
  - Allows to work differently with industry (design work, smaller companies).
  - Not tied to a single company for production and support.
- CERN Open Hardware License provides a legal basis.
- OHR site is practical, stimulating and fun for engineers.
- Good FOSS tools needed: help us make it happen!
- Many designs being developed and several are already produced by industry.
- Four years of experience show it works!