Open Hardware at CERN
an initiative for changing the way we work

Eva Gousiou on behalf of the OHWR community
Outline

- Introduction
- Why Open Hardware
- Open Hardware at CERN
- Conclusions
LHC Particle Accelerator
Studying the finest constituents of matter
Understand the very first moments of our universe right after the Big Bang
LHC: a complex machine
LHC: a complex machine

Control

Monitor

LHC: 27 km

SPS: 7 km

Booster: 0.02 km

PS: 0.7 km

p⁺
Beam Controls: Hundreds of designs
Electronic boards: Tens of components
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- Components purchased by **companies**
- Components designed at **CERN**
Electronic boards: Tens of components

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- Components designed at CERN
- Obsolete
Electronic boards: Tens of components

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- Components designed at CERN
  - Obsolete
  - Expensive
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- Bugs
Electronic boards: Tens of components

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Vendor lock-in

...
Open Hardware
Why Open Hardware

Enjoy what other people have done

- Design Reuse
- Well established standards
  - Ethernet, PCIe, WISHBONE
Why Open Hardware

- Design Reuse
  - Enjoy what other people have done
  - Well established standards
    - Ethernet, PCIe, WISHBONE

- Peer Review
- Rigorous design process

Enjoy contribution from other people
Why Open Hardware

- Make a contribution
  - Dissemination of knowledge
Why Open Hardware

Create healthier relationship with companies

- Not Free as *Free beer*
- Need to make a living!
- Most successful Open projects have paid developers
Why Open Hardware

- Create healthier relationship with companies
  - Free as Freedom
  - Need to make a living!
  - Most successful Open projects have paid developers
  - Manufacturing/Testing quality, Warrantee, Support
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Open Hardware at CERN

- site
- license
- tools
Open Hardware at CERN

- site
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Open Hardware Repository

www.ohwr.org

- Publishes everything needed to
  - Review
  - Modify
  - Manufacture
Open Hardware Repository

www.ohwr.org

- Fully open access
- Built using FOSS
WorldFIP is a deterministic rad-tol fieldbus used at CERN’s LHC for a variety of control systems. Cryogenics, Power Converters, Beam Instrumentation and other critical systems are using WorldFIP for the exchange of data between their sensors and actuators and the control and supervision level.

With ABB phasing out WorldFIP support in 2008, it was decided to insource this technology at CERN.

The insourcing project has started with nanoFIP, a rad-tol FPGA that acts as an agent in the communication over the WorldFIP fieldbus.
Open Hardware Repository

www.ohwr.org

- 100 active projects
  - 70 initiated by CERN, 30 outside
  - 60 hardware designs, 40 IP blocks

- 140 active developers
  - 12 companies
  - 10 research centers
Open Hardware at CERN
Open Hardware License

CERN OHL

- Developed by CERN Knowledge Transfer
- Defines conditions for using/modifying a design
- Persistent license
- Clear, easy to read
- Makes it easier to work with others
Open Hardware License

Under CERN OHL

- BREADPIG Balloon Mapping Kit
- miniEngine
- chirp! - the plant watering alarm
- DÉCE LUXE
- StaffRoom: Lab pomme: Worms Farm
- JERRY DIGITAL EXPERIMENT
- Led Driver
- TinkerForge
Open Hardware at CERN

- site
- license
- tools
Hardware Tools

- FPGA
- HDL simulator
- Schematics entry
- PCB layout
- Art work
- Drilling
- Pick & place
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FPGA
Efforts on Open Hardware Tools

- HDL simulator

- Schematics entry
  - PCB layout
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  - Drilling
  - Pick & place

- FPGA

Icarus Verilog

KiCad EDA Software Suite
A Success Story

The White Rabbit Case

- CERN needs

Operation coordinated with sub-ns accuracy
A Success Story

The White Rabbit Case

- CERN needs
- Based on well established standards

Operation coordinated with sub-ns accuracy
A Success Story

The White Rabbit Case

- CERN needs
- Based on well established standards
- Institutes & Companies building upon
- Peer Review
A Success Story

The White Rabbit Case

- CERN needs
- Based on well established standards
- Institutes & Companies building upon
- Peer Review
- Different products available by several companies
- IEEE standardization
A Win – Win Situation

- Better designs
  - Review, Optimize

- Designs with added value
  - Manufacturing, Testing, Warrantee, Support

- Fun :-}