

Accelerating innovation and sharing knowledge through Open Hardware

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Outline

- 1 Introduction
- 2 Open Source Hardware
- 3 Past challenges
- 4 Future challenges and conclusions

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CERN's mission

Do basic science

- Components of matter
- Interactions

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- Components of matter
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Communicate!

- Results of research
- Any other developments of use to society, coordinated by the Knowledge Transfer group

Science and Open Source

Open Source is good...

- For avoiding duplication of effort
- For getting peer review
- For maximizing impact on society
- For avoiding vendor lock-in
- For guaranteeing basic freedoms to the users

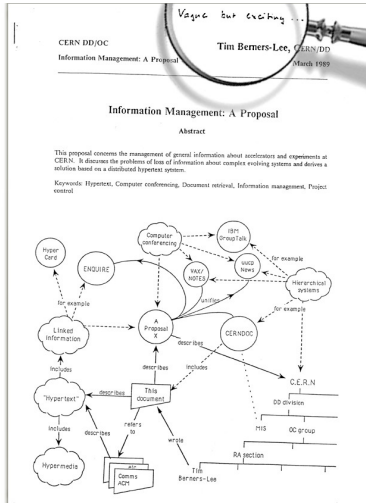
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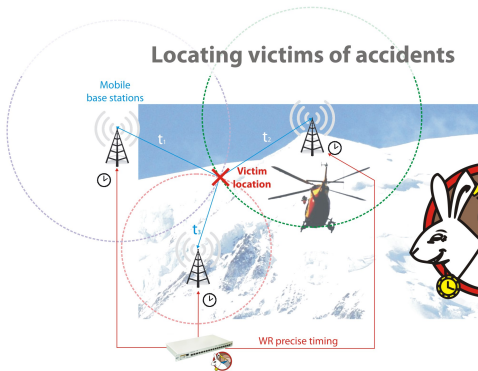
And scientific research had already proven all of these points before!

CERN and innovation



A recent example of innovation

Locating victims of accidents

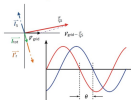


Smart power grids

Power station synchronization



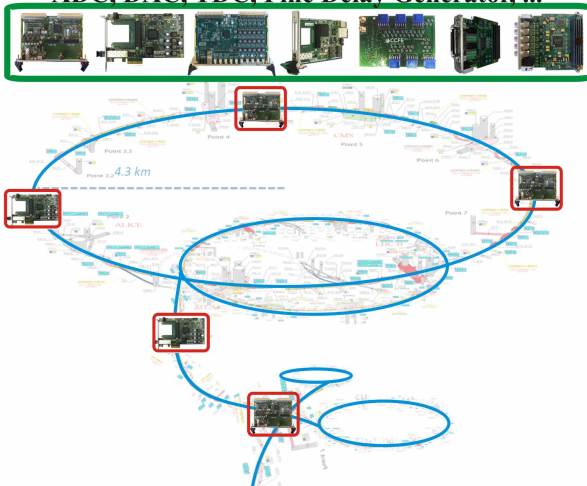
Phase & power measurements



Beams – Controls – Hardware & Timing

Our place at CERN

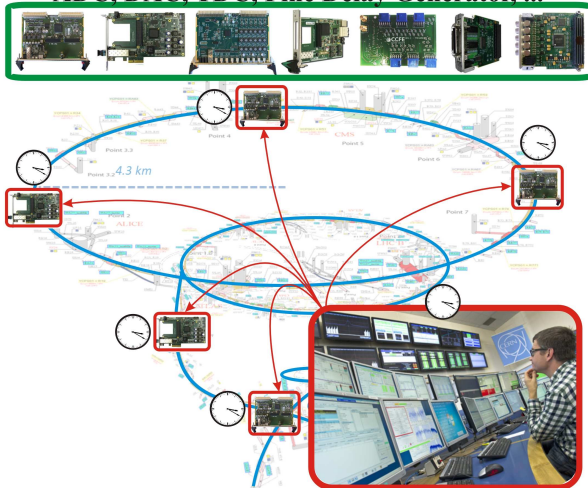
ADC, DAC, TDC, Fine Delay Generator, ...



Beams – Controls – Hardware & Timing

Our place at CERN

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A basic question

Could hardware design be as easy to share as software?

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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!

Layers of openness

- Openness is more important when the freedoms it affords can be easily used by many.
- Free access to knowledge and the ability of many to do something useful with it *can* trigger “revolutions”, like the printing press, the industrial revolution and the Internet.

Empowerment



So could this trigger a revolution?

- Distributed design and manufacturing has become available to many.
- Mass production still means big players can manufacture more cheaply.
- But other motivations (ecology, independence. . .) could trigger a customer-driven change of scenario in the future.

Prosthetic hands



Safecast



Water distribution



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Example of a project in the Open Hardware Repository (ohwr.org)

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Logged in as erikva

» Si

FMC PROJECTS » SIMPLE PCIE FMC CARRIER (SPEC)

[OVERVIEW](#)[ACTIVITY](#)[MAILING LIST](#)[ROADMAP](#)[ISSUES](#)[NEW ISSUE](#)[NEWS](#)[DOCUMENTS](#)[WIKI](#)[FILES](#)[REPOSITORY](#)[SETTINGS](#)

OVERVIEW

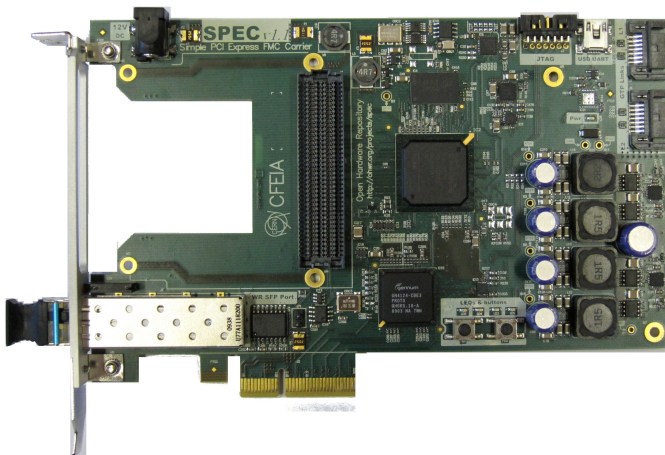


A simple 4-lane PCIe carrier for FPGA Mezzanine Cards (VITA 57). It has memory and clocking resources and supports the White Rabbit timing and control network.

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

SPEC: Simple PCI Express FMC carrier

Made in Spain, The Netherlands & Poland



CERN Open Hardware License – ohwr.org/cernohl

Provides a solid legal basis

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

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Provides a clear legal environment

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

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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.

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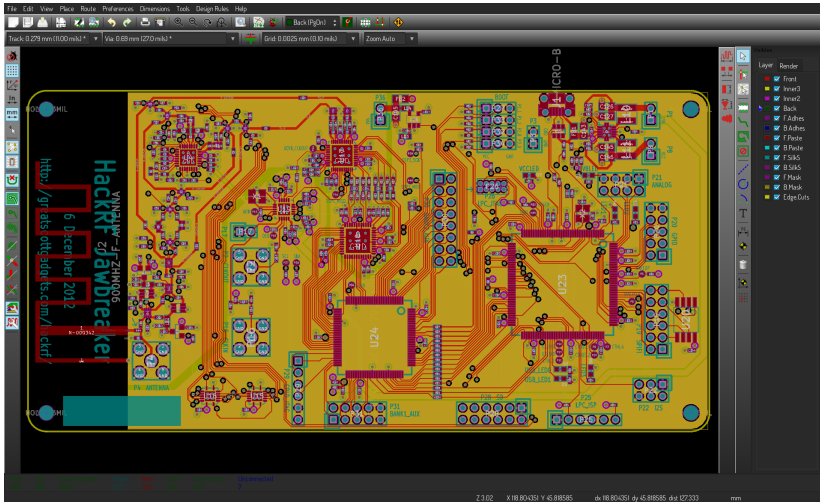
Takes into account hardware production and distribution

- When producing and distributing licensee is invited to inform the licensor.
- Distributed HW must come with documentation.

Business models: dispelling the commercial vs open myth

		Commercial	Non-commercial
Open	Open	Winning combination. Best of both worlds.	Whole support burden falls on developers. Not scalable.
	Proprietary	Vendor lock-in.	Dedicated non-reusable projects.

Free design tools



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Economic

Some people would like to but cannot afford to work on open source. Can some bright economist work out a solution?

Legal

Licensing of free software is mostly based on copyright. This has limits when applied to hardware. We may need to explore other instruments, like contracts and marks.

The role of public institutions

The goal here is not profit but to maximize impact on society.
We need tools to quantify impact of OSHW and free software,
and a bit of organization.

Six years of experience show it works

SENEN Solutions
Home Projects Services Products Compe
WR Switch (18/8 SFPs)
The White Rabbit Switch (WRS) is the key component precision timing and high synchronization over an Ethernet. Actually it exists two standalone SFP versions:
■ The WRS-3/18 version which is the standard version
■ The WRS-3/8 version with only 8 SFP connectors us
Main Features
■ Virtex-6 FPGA (XC6VLX130T)
■ ARM (Atmel AT91SAM9G45) @ 400MHz
■ 18/8 x SFP cages
■ 32M x 16 DDR2
■ Two 512Kx36 QDRII SRAM
■ Ethernet 10/100 PHY
■ 256 MB Nand Flash
■ 8 MB SPI Boot Flash
■ 5 SMC coaxial Clocks (PPS I/O, 125MHz I/O, 10MHz
■ 1.6 GHz VCO (AD9516-4)
References

INCDATA
COMPUTERS
Design and Manufacturing of technical automation systems
Home News Products Exhibitions References Support Contact
Products by Standard • FMC • 4ch 105 Mps 30 MHz 14 bit ADC
4ch 105 Mps 30 MHz 14 bit ADC
Features:
4 channel FMC ADC module
Max. sample rate 105 Mps
Analog bandwidth 30 MHz, DC-coupled
Bits/sample 14 bit
ENOB 11, 11.5, 11.7 bit @ +/-50mV, +/-0.5V, +/-5V range)
Channels 4
Connectors 4 x LEMO 00 for signals, 1 x LEMO 00 for trigger
Input impedance 1 kOhm / 50 Ohm - software selectable

CFSD TECH
Instruments S.A.
NEWS • OFFER • REFERENCES • INVESTOR RELATIONS • COMPANY • CAREER • CONTACT
Create the Impossible
Products List
{ Simple PCIe FMC carrier (SPEC)
■ FMC DIO 5m TTL x
■ FMC ADC 120M 140-40m
■ FMC ADC 120M 140-14m
■ FMC DIO 1m 4m
■ Virtex Kintex 7000-11-1
standalone with 13 SFP
ports (WRS 5/18)
■ Simple PCIe FMC carrier (SPEC)
The FMC PCIe Carrier is an FMC carrier that can hold one FMC card and an SFP connector. On the PCIe side it has a 4-lane interface, while the FMC mezzanine slot uses a low-pin count connector. This board is optimized for cost and will be usable with most of the FMC cards designed within the OHR project (e.g. ADC cards, Fine Delay). For boards needing more possibilities (e.g. programmable clock resources, fast SRAM, fast interconnect between carriers), the FMC PCIe Carrier or its VME counterpart can be used.

? Ask about the product
! Download manuals
FPGA

janzttec
Home Company
Embedded Computing
Custom Design
Custom Products
VMEbus
VMEIO-32
VMEIO-32
VMEIO-32
The VMEbus and the permit system architecture. Here you can find the product family in addition to it.

GC Pass
JC
1137405
Simple VME FMC Carrier
V1.0
(SPEC)
40-PIN-SPEC
www.janztec.com
HCGV010
CRO000020