

Open Hardware in Creotech

**from a point of view of a small hardware
company**

**by
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Basic requirements:

- **Everything** needed to review and modify the design and to produce the final hardware must be **published**.
- The project **must** present an interest to the community of electronics designers for **experimental physics** facilities.

The result:

Open Hardware is excellent from the point of view of CERN and experimental physics community:

- it is developed for free
- it solves certain problems of the community

Can it be also good for small companies ????

Business – is making **money** not giving things for **free** !

Why Open Hardware? :

Big Hardware Company

- we will invest 0.1% of our resources (we are big) → not a big cost for us
- we will for sure find some applications of OHW devices in our own hardware designs → sell these complex devices, and make money
- problems that we have/might have will be solved without our investments (someone else will solve it)
- we are following the trends and could react more quickly on demands from this market

OHW is good for us

Small (not only small) software companies:

- we will invest 80% of our resources → it a big cost for us
- we will understand the hardware that is given for us for free
- we will prepare software solutions for this hardware, software is our own and we have copyrights for it
- we will sell the software+hardware solution and earn money

OHW is good for us

Small hardware companies:

- we will invest 80% of our resources → it a big cost for us
- we will give for free an effect of our work
- someone else will produce it and sell under its brand

OHW – why do we want to take part in that ???

Creotech point of view...

A few words on the Creotech:

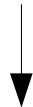
- Small company: ~12 workers (engineers)
- Special equipment for tests + for production of short series of highly sophisticated solutions
- Company started by post-CERN workers and people connected with other scientific laboratories

Our business model:

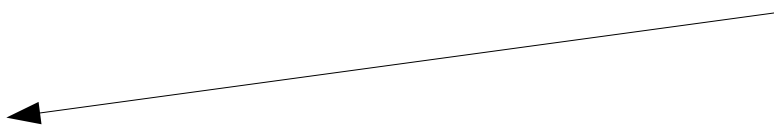
We take **orders** from scientific institutes



Orders are for highly **sophisticated** equipment



Sophisticated equipment should be prepared with a close **collaboration** with institutes



We **share** full knowledge of our products with institutes that put an order
We **cooperate** closely at every step of designing the equipment

Close collaboration you may call: Semi-Open Hardware methodology

Open – for institutes for which the project is being developed

Open – implementation in Creotech as well as in the institutes

Semi – only Creotech – and “clients” (clients also developers) not free for all
(at the moment...)

One example of this approach:

The GEM Supply Unit (GSU)

Special capabilities which makes it specially suited for GEM detectors. All voltages are generated as a sum of voltage sources instead of independent sources used in conventional solutions. This approach enables safe operation of detector as well as precise regulation of inter-electrode voltage instead of absolute electrode value. Moreover, after detection of HVU over-current event it can immediately and safely disconnect outputs, preventing GEM from being destroyed by an electric arc.

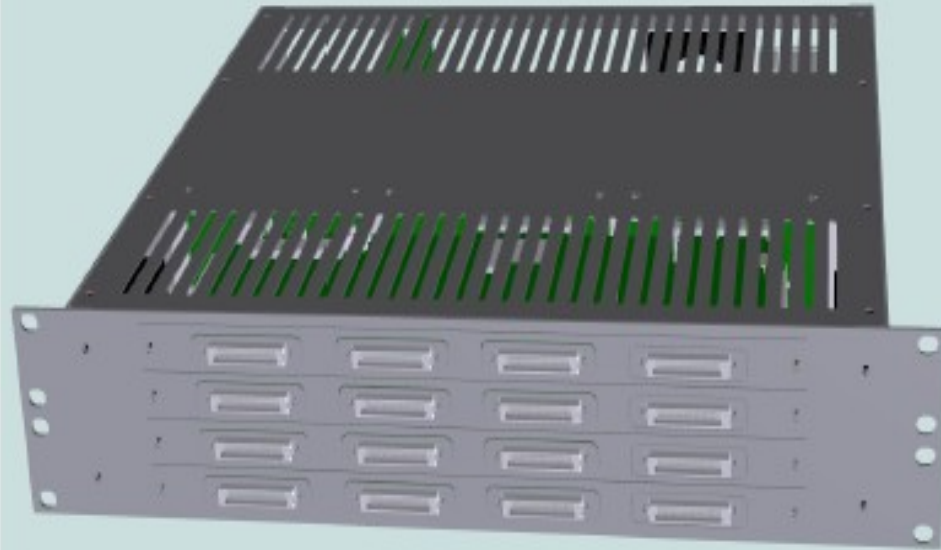
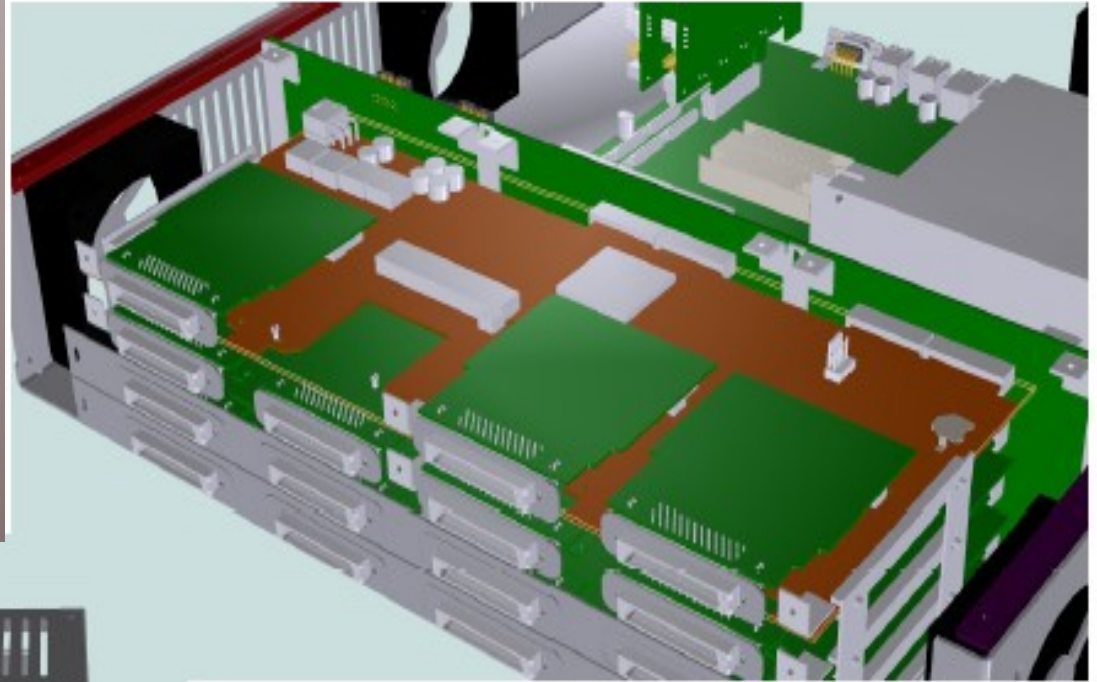
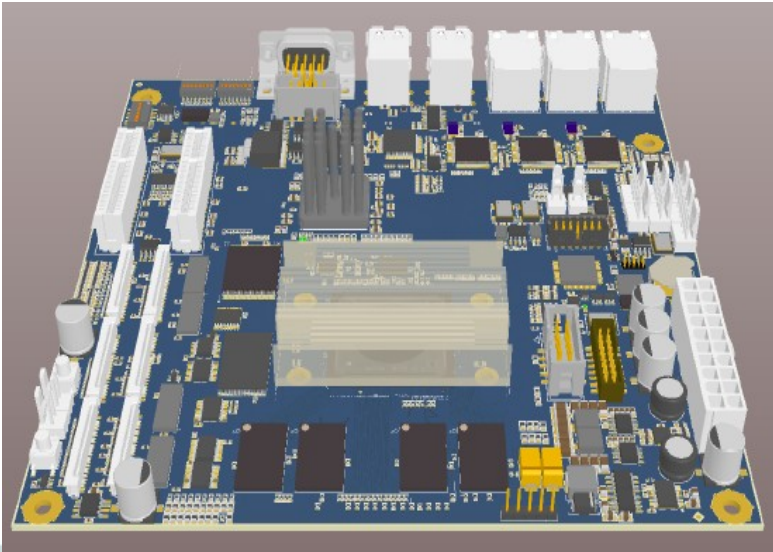


Product develop with **close collaboration** with Polish Institute for Nuclear Synthesis collaboration makes the **costs much smaller**, development **time faster**, product **100% satisfies** the needs, tests are being done “on-line”. **Better, Quicker, Cheaper!**

How to make a full OHW approach and earn money?

The Project - High speed data acquisition, concentration and processing Platform for Nuclear fusion facility

- Modular high speed processing and acquisition backplane with recent FPGA technology
- Extremely low and predictable latency due to fully synchronous operation unlike existing platforms
- IEEE1588 and White Rabbit support for sub-ns synchronisation
- Up to 36 FMC modules in 4U rack-mount case
- Dedicated up to 4 FMC modules for 10 gigabit communication
- 25Gbit/s link between FMC and carrier, 20Gbit/s between FMC and FMC
- PCIe Gen II non blocking switch (5Gbit/s) between all the FMCs
- Advanced diagnostics and self-recovery
- Advanced FPGA configuration and bitstream encryption
- Very low jitter clocking resources (~0.3ps RMS)
- Fast multicore Power PC or x86 system controller running Linux
- Automatic FMC detection and configuration



2U 19" rack-mount case for 18 FMC modules
4U 19" rack-mount case for 36 FMC modules

Possible applications of single 4U carrier

- 512 channels, 10bit, 100MS/s acquisition for photonic detectors (visible, X, Gamma) – spectrometers, 2D imaging.
- 128 channel Software Defined Radio, 0.4-4GHz for passive radar
- 1024 channels, 16bit, 1MS/s acquisition for process control
- Fast feedback multi-dimensional cavity controller for accelerators beam control (i.e. free electron lasers)
- Data concentrator for 64 fibre channels
- Supercomputer, up to 1Tera Instructions Per Second (512 ARM cores)
- DSP computing platform, up to 256 cores at 1.5GHz
- Country or region - scale positioning system (with WR support)
- Automatic test equipment

Great isn't it ?!

But....

- The costs of the development are **high**
(at the moment several Polish institutes are being involved, but it is still not enough)
- The costs of the tests are **much higher**
- There is a high probability that the scientific community will “not buy it”
- risk of a new not-proven standard !
- There is a high probability that a large company will quickly propose something similar
(with copy-rights and patents)
- There is a high probability that no-one will hear about this (another forgotten brilliant :o) idea)...

The solution is Open Hardware!

By giving the core of the system to open hardware directory we will:

- **Let people know that it is existing and is great !**
- **Convince people to develop it, check and provide their improvements**
- **Lower significantly the costs of development**
- **Make it cheap (cheaper than other standards)**

A piece of cake for Creotech:

- **We are a proponent of this standard and we plan to make a production**
- **As a proponent we believe that we obtain several contracts for production of the system that we know the best**
- **As a proponent we believe that we will support the institutes that are implementing the system**
- **As a proponent we plan to develop different extensions to the core of the system, the extensions will be sold as our own products**

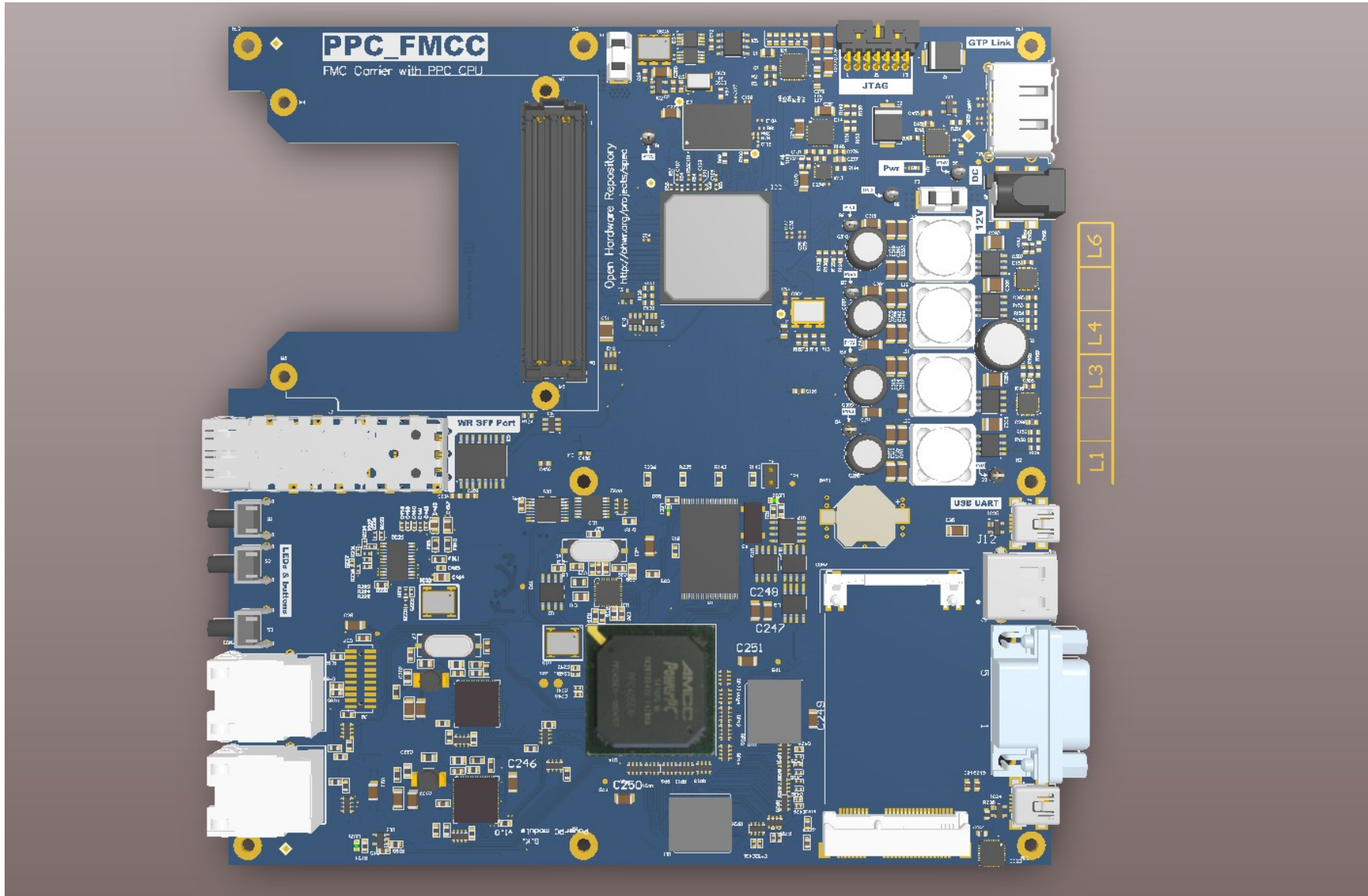
The new product-line/standard will be added to OHW soon – now we are defining the core and extensions – to put a line between what is open and what is closed

Still we are extensively working on FMC and White Rabbit itself:

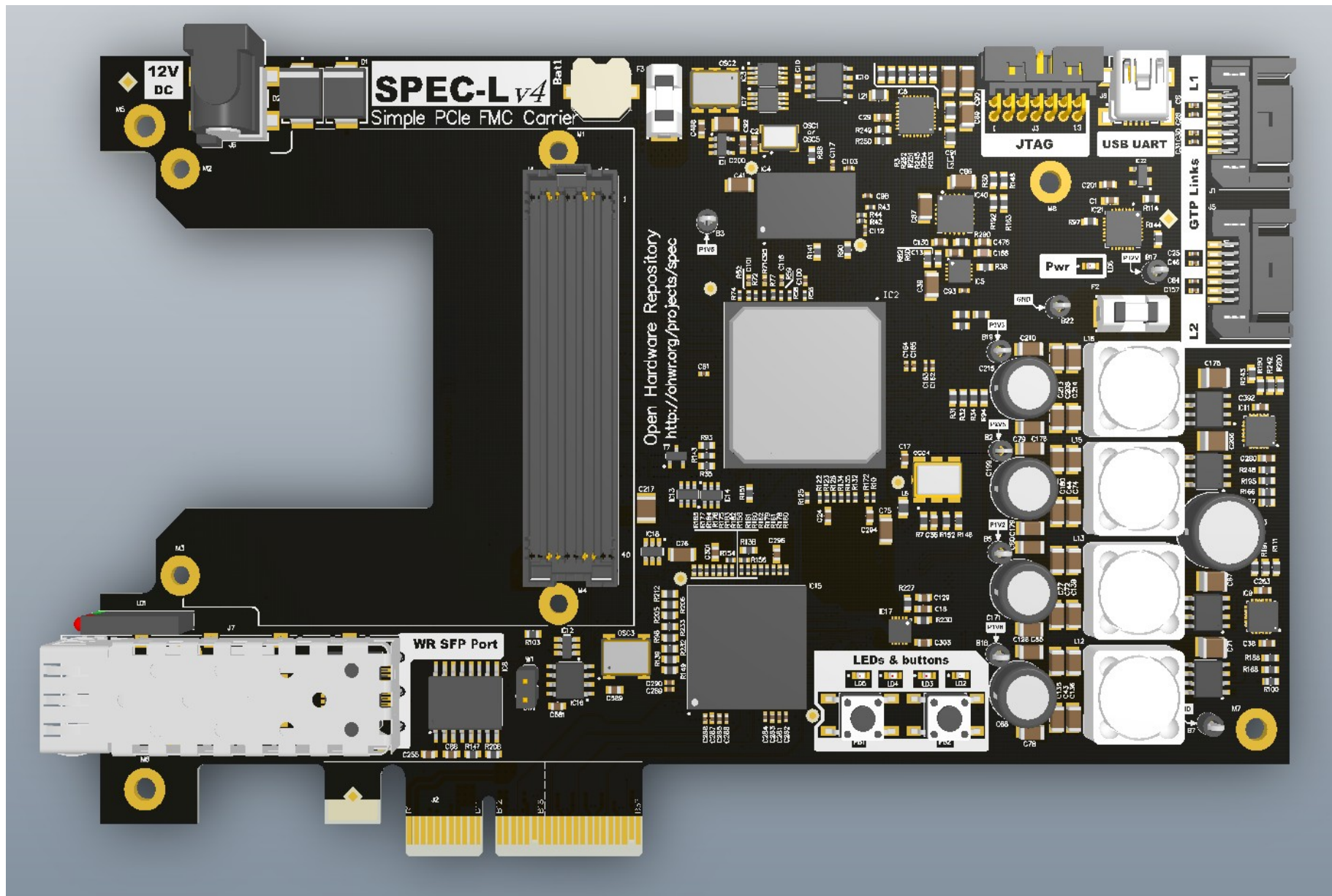
- next production of the new SPEC-L boards will start in a few days**
- we are also the developer of SPEC boards so all the produced boards are carefully tested and not only mounted.**
- we develop another carriers and FMC boards that are based on OH projects**
- the boards are then supported and treated in the same way as our own products.**

Stand-alone FMC carrier, based on SPEC, with Power PC processor and Linux

- will be added to the OHW repository soon



SPEC-L with large, Spartan6-150 FPGA and bit-stream encryption - will be added to the OHW repository soon



THANK YOU