

# **Open Hardware MTCA development at Creotech Instruments SA and WUT**

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# Agenda

- A few words about Creotech Instruments SA
- What is Open Hardware
- OH MTCA.4 development at CTI and WUT
- WR-MCH

# Company history

## Creotech Instruments S.A.:

- Creotech Ltd. was founded in 2008 by three scientists of Warsaw University and Warsaw University of Technology, who also worked at CERN, Switzerland
- 2011 – joint-stock company Creotech Instruments S.A. was created, employment: 5 full time job equivalents (FTJE)
- 2013 – first cleanroom facility built 30m<sup>2</sup>, start of space projects

# Company history cont.

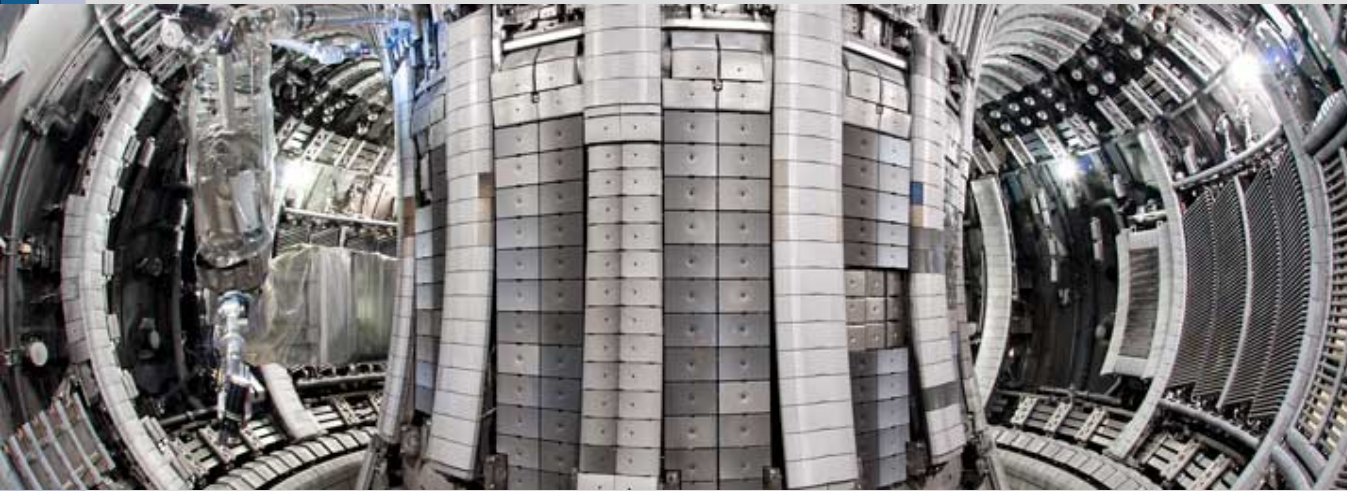
## Creotech Instruments S.A.:

- August 2014 – state owned Industrial Development Agency invested in Creotech – (the first investment of the Polish state in a private company after II WW), 14 FTJE
- November 2014 – second cleanroom built 120m<sup>2</sup>, 5 space projects in realisation (4 for for ESA) , 5 in logbook (4 for ESA), 4 projects for scientific facilities in realisation, 16 R&D projects, 35 FTJE (3 PhD, 28 engineers)
- December 2014 – 2 proposals on small satellite development and integration, automatic electronics assembly line



# Who we are?

Our proprietary solutions were tested in international research projects



# Creotech technological base

- Imaging systems based on high-end, high resolution digital cameras
- Electronic signal processing systems
- Instruments and satellite subsystems
- Electronics assembly technologies according to IPC, MIL, ECSS standards
- Mechatronics manufacturing

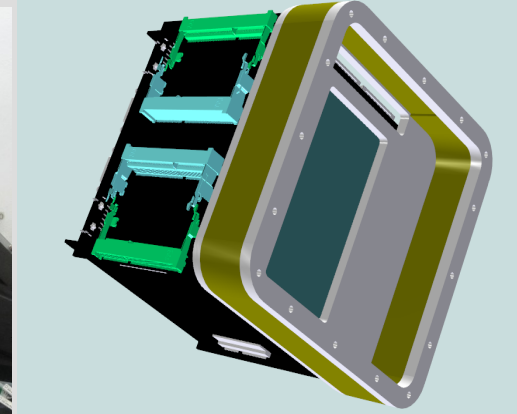
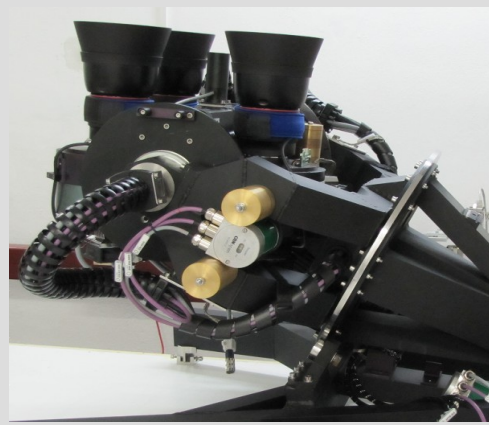
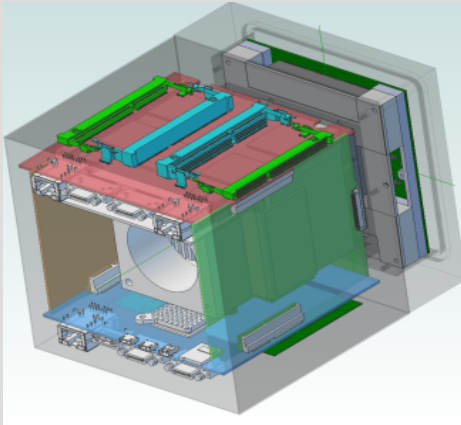
# Newly built clean-room





# We do it not only for science..

But interaction with scientific projects improves our skills and know-how



# How the OHWR gives us business opportunity

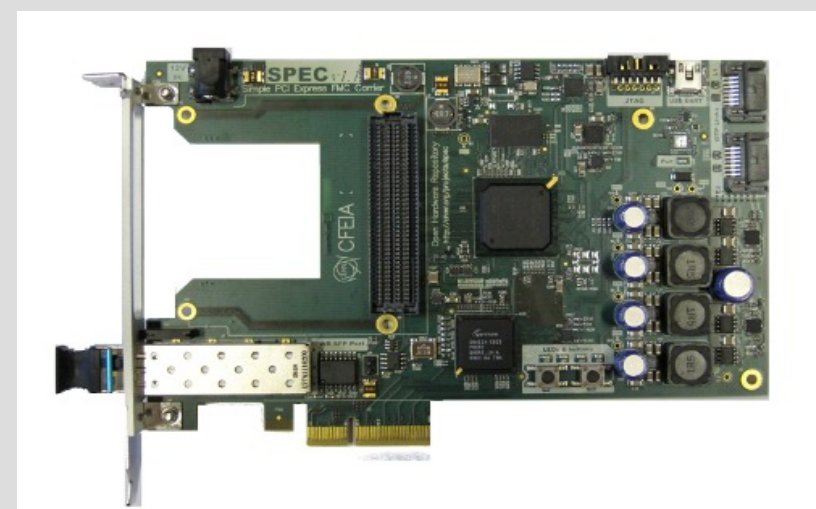
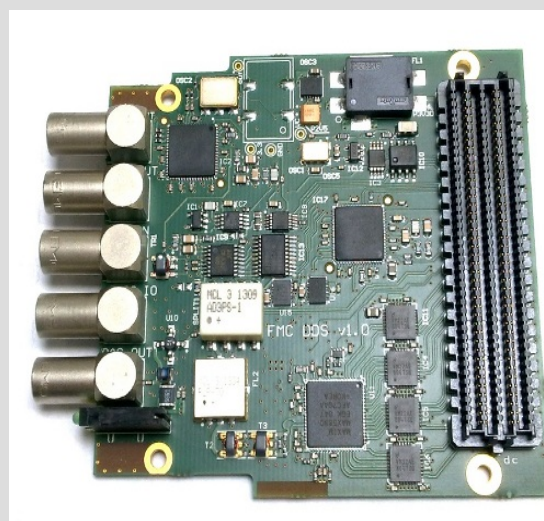
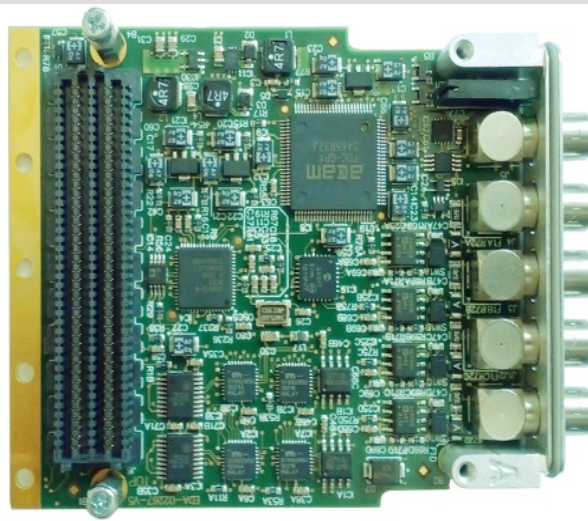
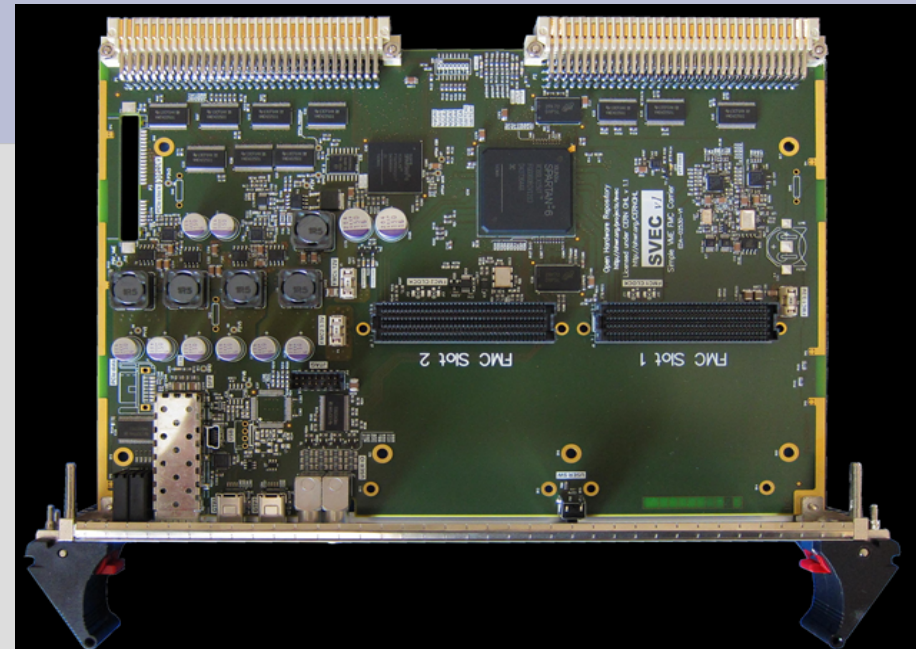
- It's great place to **advertise company capabilities**, skills, expertise and collect more orders
- It's **place to exchange ideas**, collect feedback and product improvements
- Here the company may show realized projects and get recommendations
- Sharing hardware and firmware files encourages other companies to do the same and lets us gain part of their know-how
- Next products can be created much **faster** thanks to modification or **re-use of existing ones**, developed and tested by someone else
- Thanks to opening design files in early stage of product, other engineers may **find bugs or suggest modifications** which leads to better product – **the peer review**
- By sharing own product HW and FW files, company **gets vantage over competition** – some clients will choose such solution which they can control, modify or repair in the future (after warranty period)

	Commercial	Non-commercial
Open	Best of both worlds	Whole support burden falls on developers
Proprietary	Vendor lock-in	Dedicated non-reusable projects



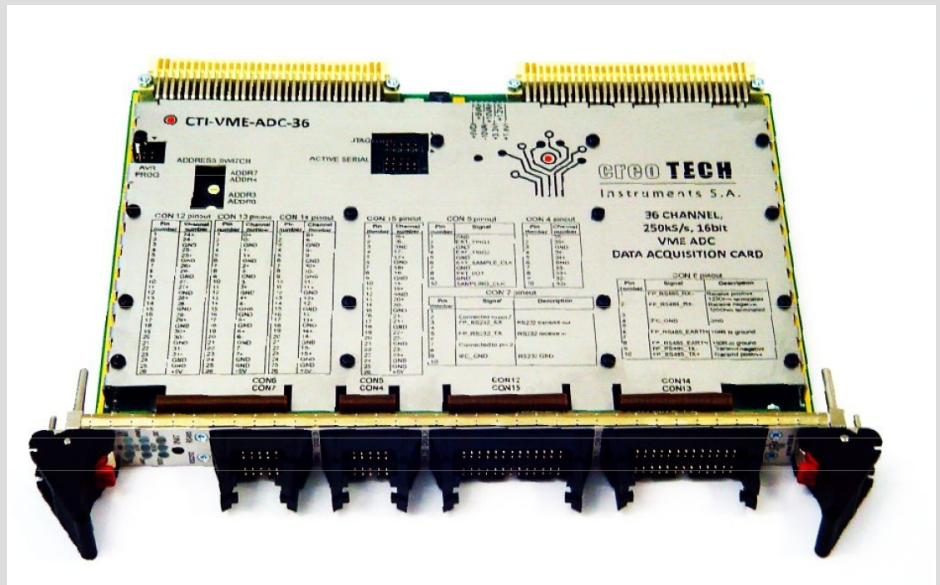
# How we started with OHWR : SPEC, SVEC, TDC/DTC

- SPEC, SVEC, FMC DEL, FMC DDS, were outsourced by CERN to CTI
- Several hundreds pieces produced by 3 companies
- Used worldwide



# VME ADC board

- 36 ADC channels, simultaneously sampling
- 16 bits
- 250kHz
- 64MB of RAM
- MPV901 compatible
- Main application: SEM grids
- OHWR design



**Product developed in close collaboration with CERN,  
180 pieces produced  
Application: Linac 4 SEM grid readout, DC transformer DAQ  
CERN requested OH licensing in call for tender**

# Examples of successful OH projects

## COMPANIES



The following companies are actively using the OHR site to develop or produce open hardware, software and drivers. These companies may be paid for the open developments. Please note that companies may in fact be involved in more areas than described in the table below. This table only reflects work done in the OHR site.

Name	Description	Country	HW development	HW commercialisation	HDL development	SW development	Projects	Members
<b>Cosylab</b>	Your trusted control system partner	Slovenia	✓		✓		2	3
<b>Creotech</b>	An enterprise of zeal and excellence	Poland	✓	✓	✓	✓	31	12
<b>Digicom Electronics</b>	Detail oriented, Integrated solutions, Guaranteed, Industrious, Capable, On-time, Manufacturing Excellence	USA		✓			1	0
<b>ELMA</b>	Your solution partner	Switzerland	✓				1	1
<b>Gnudd</b>	Helping our partners to master technologies	Italy				✓	18	2
<b>HLP Technologies</b>	Create Design Develop and Maintain	France	✓	✓	✓	✓	1	0
<b>Igalia</b>	Open source consultancy for innovative projects	Spain				✓	2	3
<b>INCAA Computers</b>	Your partner in automation	The Netherlands	✓	✓		✓	5	2
<b>Integrasys</b>	Building Success from Innovation	Spain			✓	✓	2	3
<b>Janz Tec</b>	Industrial Computing Architects	Germany		✓	✓	✓	2	0
<b>MagentaSys</b>	MagentaSys	Switzerland	✓				2	0
<b>Milky Mist</b>	Eyecandy on a Chip	France			✓		1	1
<b>OCLogic</b>	Hardware design and simulation	UK			✓	✓	1	0
<b>ORSoC</b>	FPGA, ASIC, DSP – embedded SoC design	Sweden	✓				1	0
<b>Seven Solutions</b>	Your reliable open company	Spain	✓	✓	✓	✓	18	6
<b>Splendeo Innovación</b>	Intuitive, easy to use web applications	Spain				✓	1	1

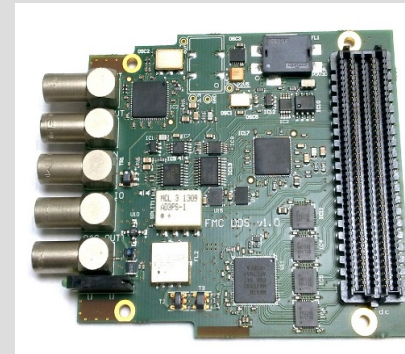
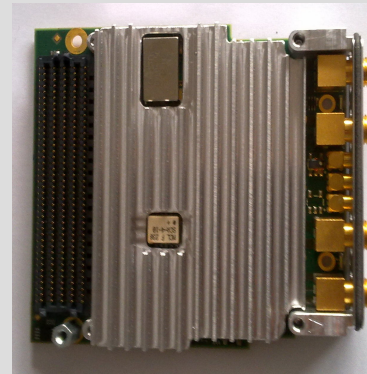
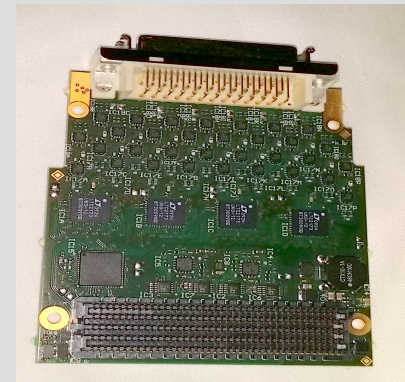
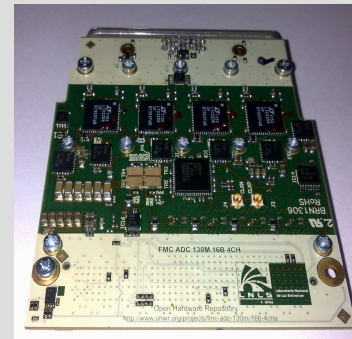
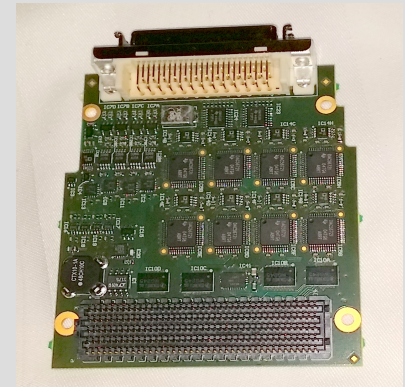
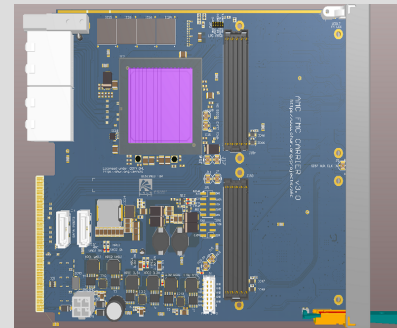
## Glossary

- HW development: Hardware development
- HW commercialisation: Hardware commercialisation
- HDL development: Firmware development (e.g. VHDL)



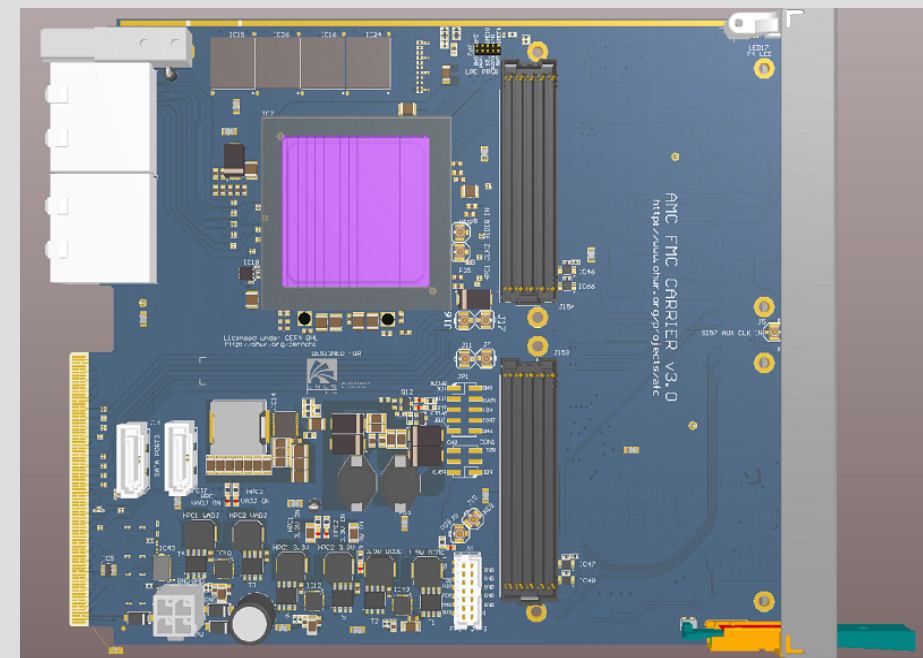
# MTCA.4 development at CTI and WUT (OHWR)

- AMC FMC v2 (Artix 7)
  - AMC FMC v3 (Artix 7) with RTM
  - AMC FMC with Kintex 7 FPGA
  - AMC QSFP (UltraScale) \*
  - MTCA micro-chassis
  - AMC CPU
  - RTM SFP
  - AMC DSP \*
  - WR MCH
- \* during development



# AMC FMC board

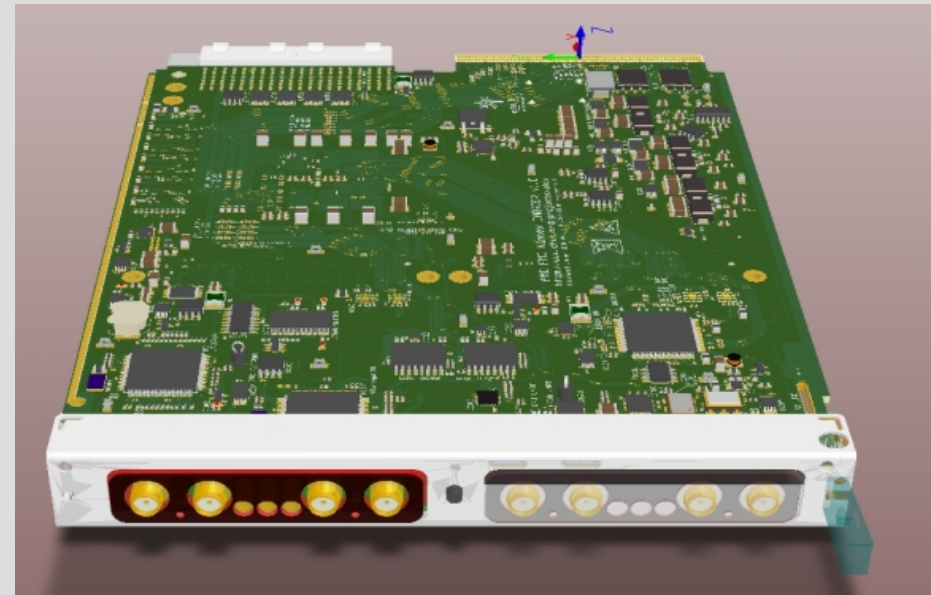
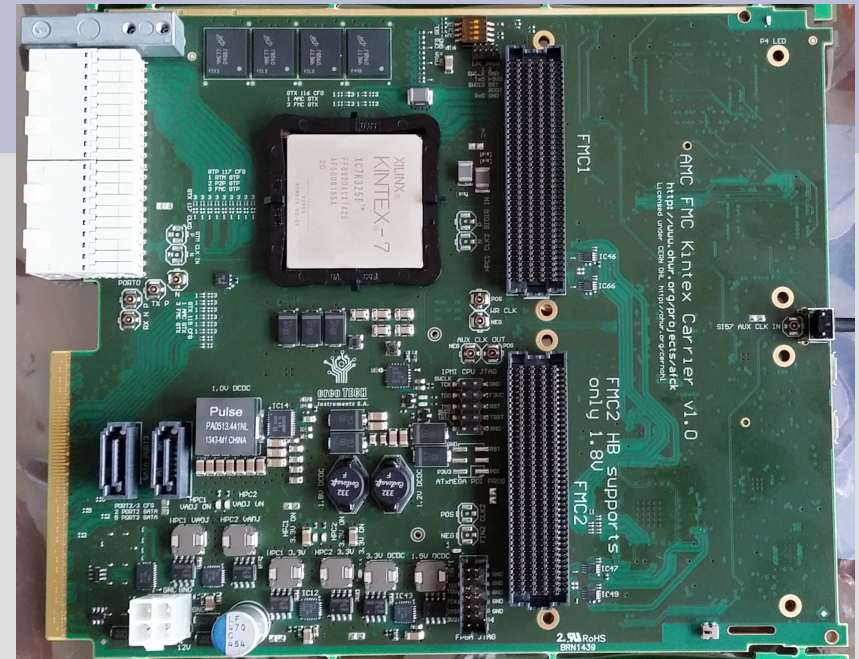
- 7-series FPGA, Artix 200T
- Dual HPC FMC
- Flexible clock crossbar
- 2Gbit SDRAM@400MHz
- 2x 256Mbit FLASH
- Custom NXP MMC (open!)
- SCANSTA JTAG switch
- **WR timing receiver**
- Version 3.1 with RTM
- Used for GSI TMS, CBM, LNLS, CCFE and others





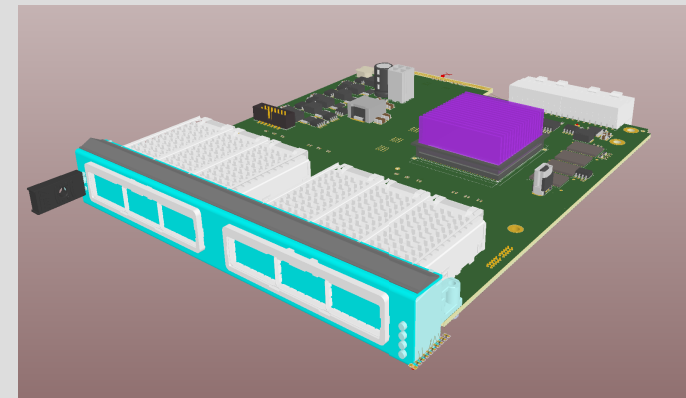
# AMC FMC board – Kintex version

- 7-series FPGA, Kintex 350T
- Dual HPC FMC
- Clock crossbar
- 2Gbit SDRAM @ 800MHz
- 2x 256Mbit FLASH
- Custom NXP MMC (open!)
- SCANSTA JTAG switch
- **WR timing receiver**
- Version 1.0 with RTM
- Used for GSI CBM and passive radars



# AMC FPGA QSFP board (CBM)

- Kintex Ultra Scale FPGA
- 6 **QSFP**, 24 x10Gbit/s optical links per board
- RTM for additional QSFP and SFP+ optical transceivers
- clock distribution circuit with crosspoint switch, VCXO, WR clock recovery
- DDR3 SRAM, 800MHz, 3 individual controllers
- Dual configuration FLASH.
- Stand-alone operation possible
- Coming soon



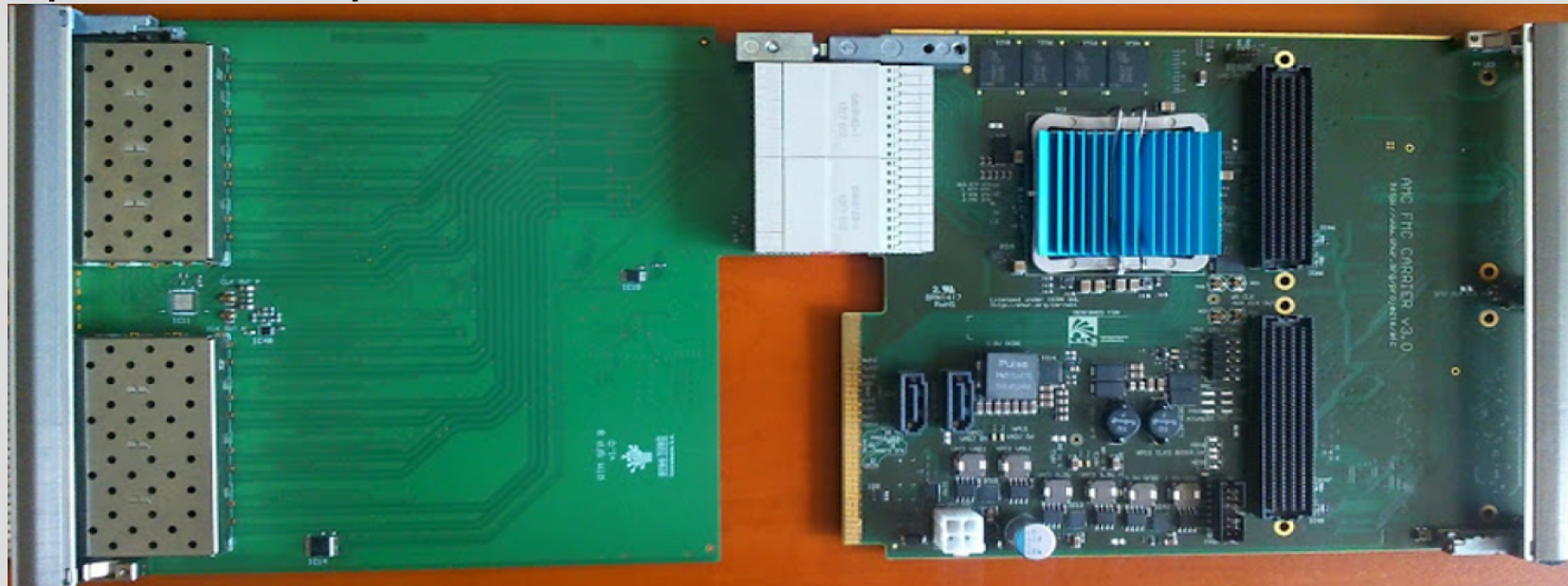
# AMC-CPU-COM EXPRESS 6

- Troubles with Concurrent i7 CPU and Vadatech crate interoperability
- Own AMC-CPU designed.
- No more troubles with IPMI
- Recent I5 & I7 cores
- Supports SSC, FP1, FP2
- Gen 3 PCIe switch
- FPGA extension slot
- Plenty of IO, USB, eSATA, VGA
- mPCIe (WiFi, 3G modem)/ mSATA
- 2 gigabit ports with P0, P1 support
- Low cost, i5 CPU < 2k EUR



# RTM-SFP+8

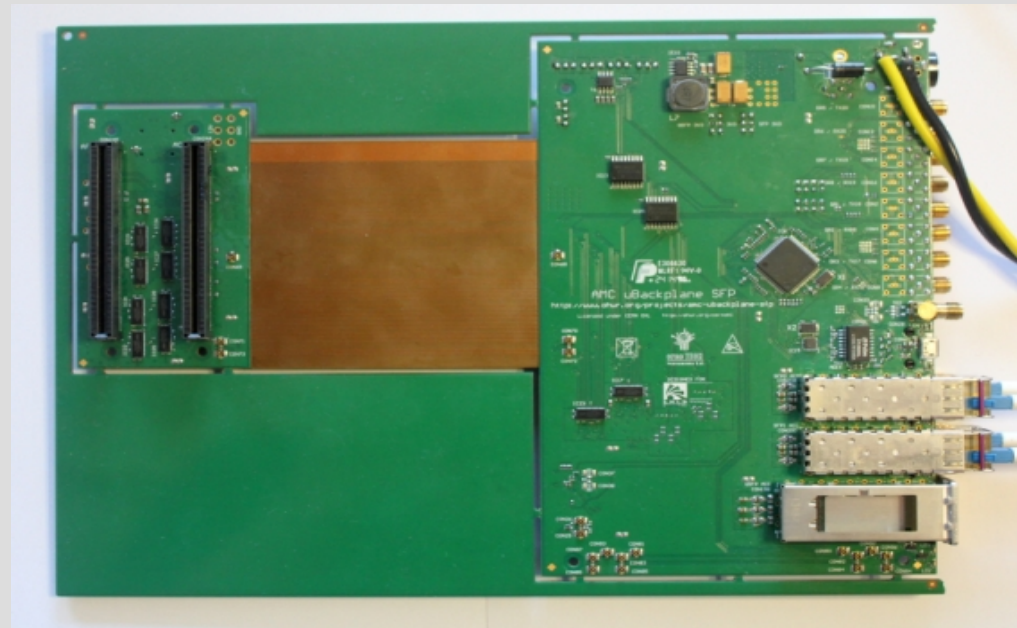
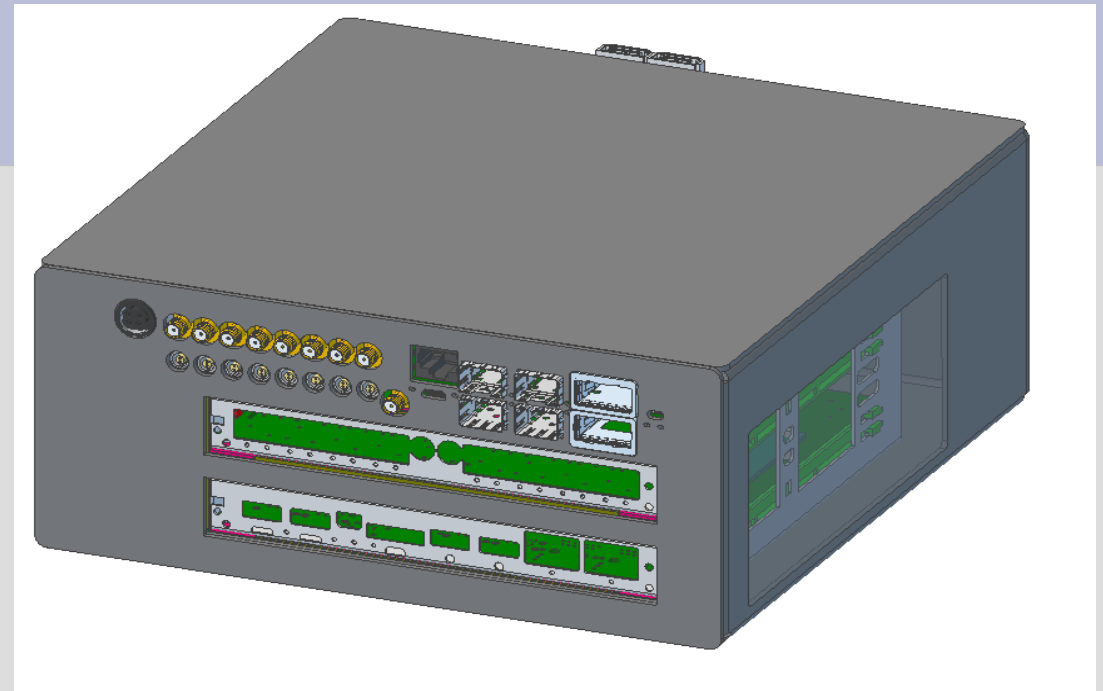
- Compatible with:
  - AMC-FMC v3
  - AMC-FMC-K (AFCK)
  - WR-MCH\*
- 
- 8 SFP+ cages
  - Clock input and output





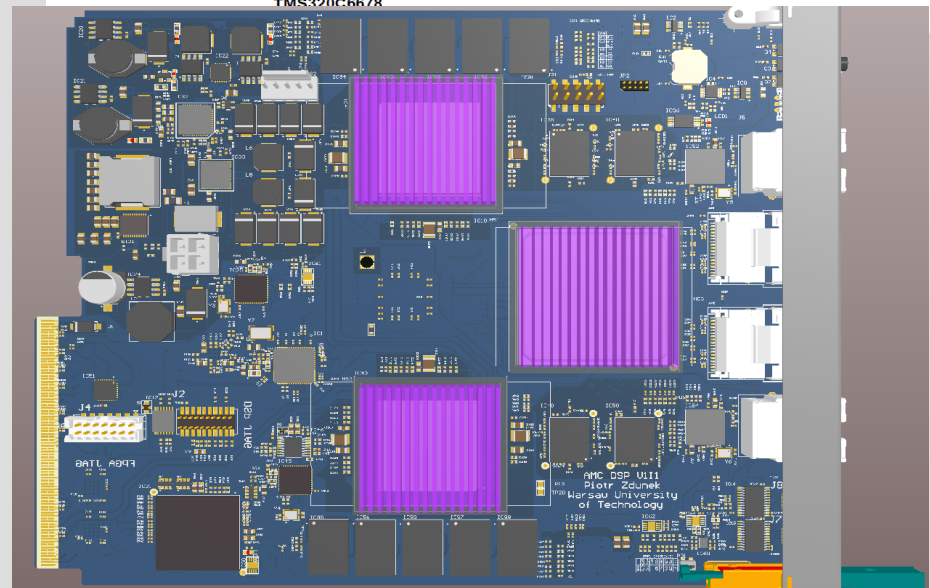
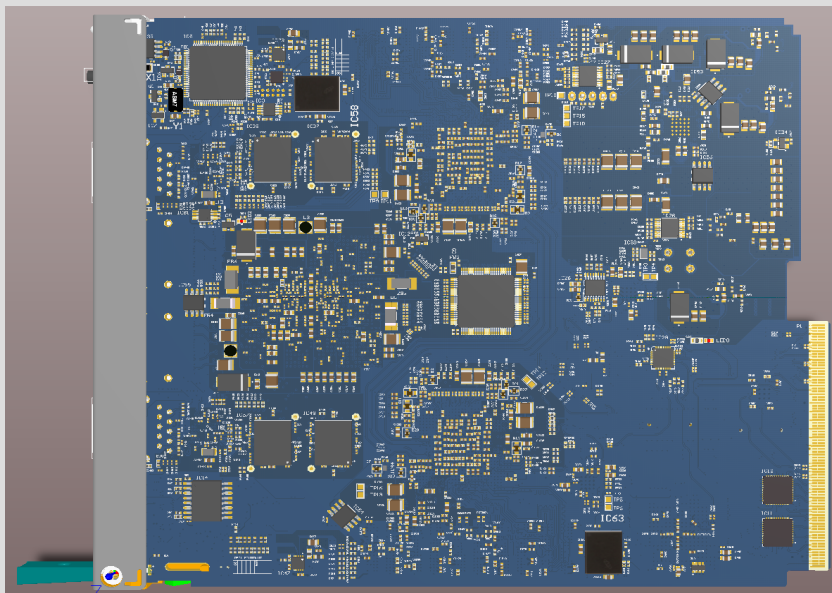
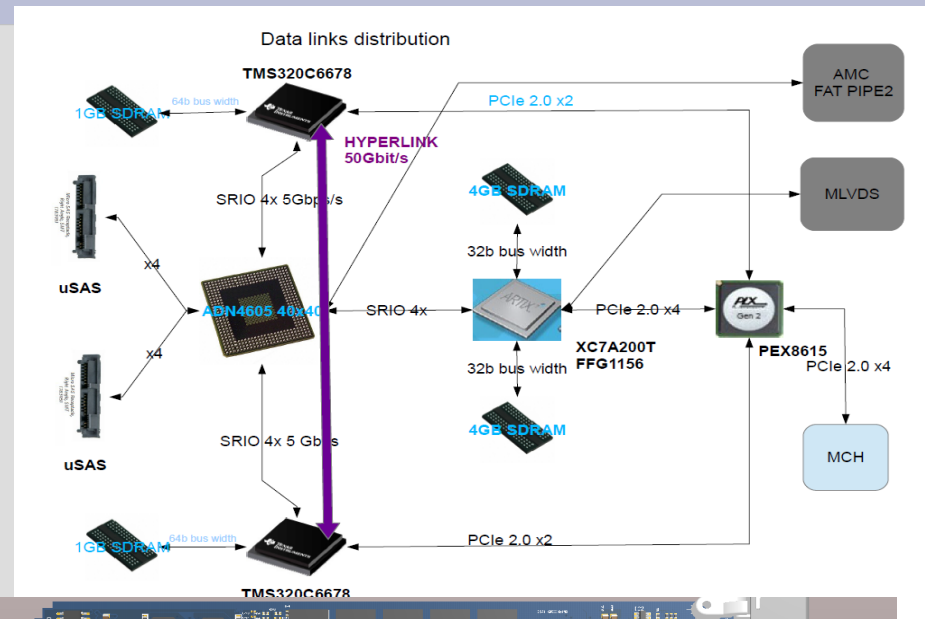
# Two slot micro chassis

- 2 AMC slots
- Ports 0, 1 as SFSP+
- FP as QSFP
- Configurations:
  - CPU+AMC
  - AMC+AMC+2xPCIe over fibre
  - AMC+AMC +2x 10Gb Eth over fibre
- RTM version in development
- Stainless steel, industrial temp range
- Applications: passive radars, remote sensing and protection in Tokamaks



# AMC DSP accelerator – 16 cores with flexible crosspoint switch

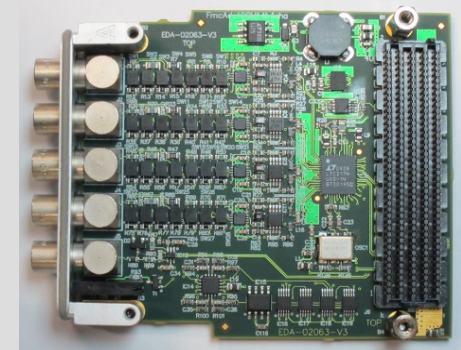
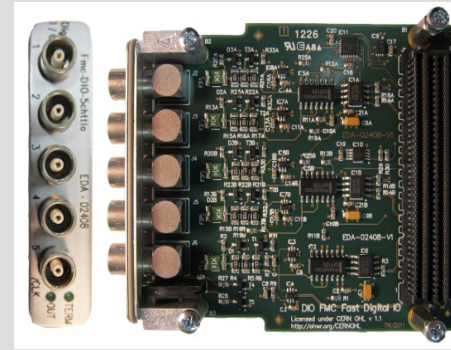
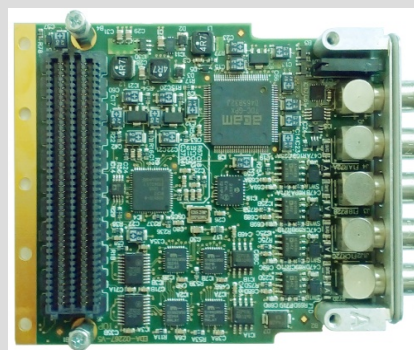
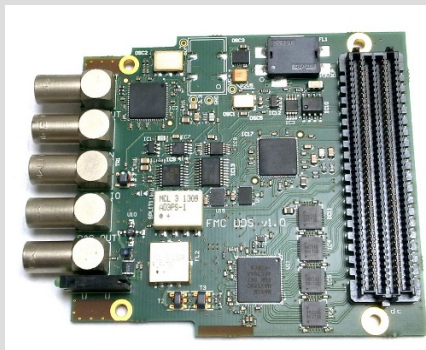
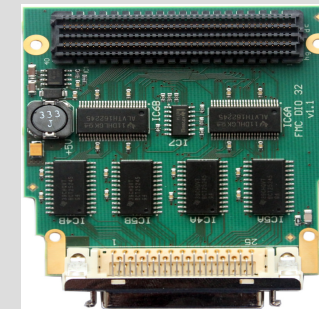
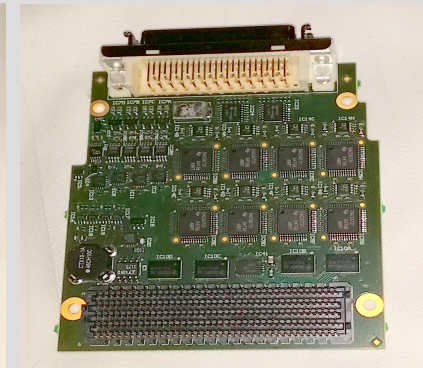
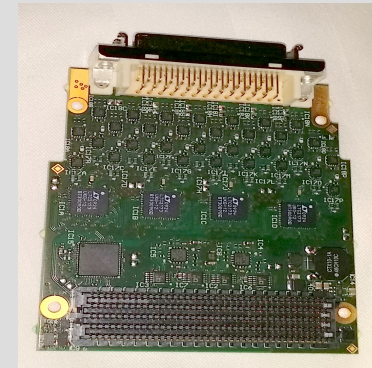
- 16 TI DSP cores
- Artix FPGA
- Crossbar switch
- 2x 20Gbit quad lane mSAS connectors
- 2x Gigabit Ethernet
- Designed for GEM detector signal processing
- Prototype stage





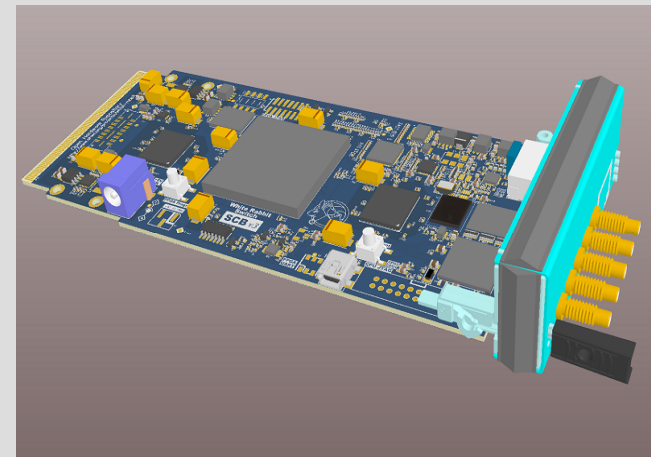
# FMC development – boards compatible with AFC/AFCK

- FMC ADC 100M 14b 4CHA
- FMC ADC 125M 14b 16cha
- FMC DAC 100M 12b 16cha
- FMC ADC 130M 16B 4cha
- FMC ADC 250M 16B 4cha
- FMC TDC/DTC
- FMC DEL 4cha 1ns
- FMC fast DIO 5
- FMC DIO32
- FMC LVDS32\*
- FMC HV +/- 8kV \*
- FMC SENS 12cha \*
- FMC DDS (WR-RF)
- FMC ADC 125M 14b DAC 600M 16b

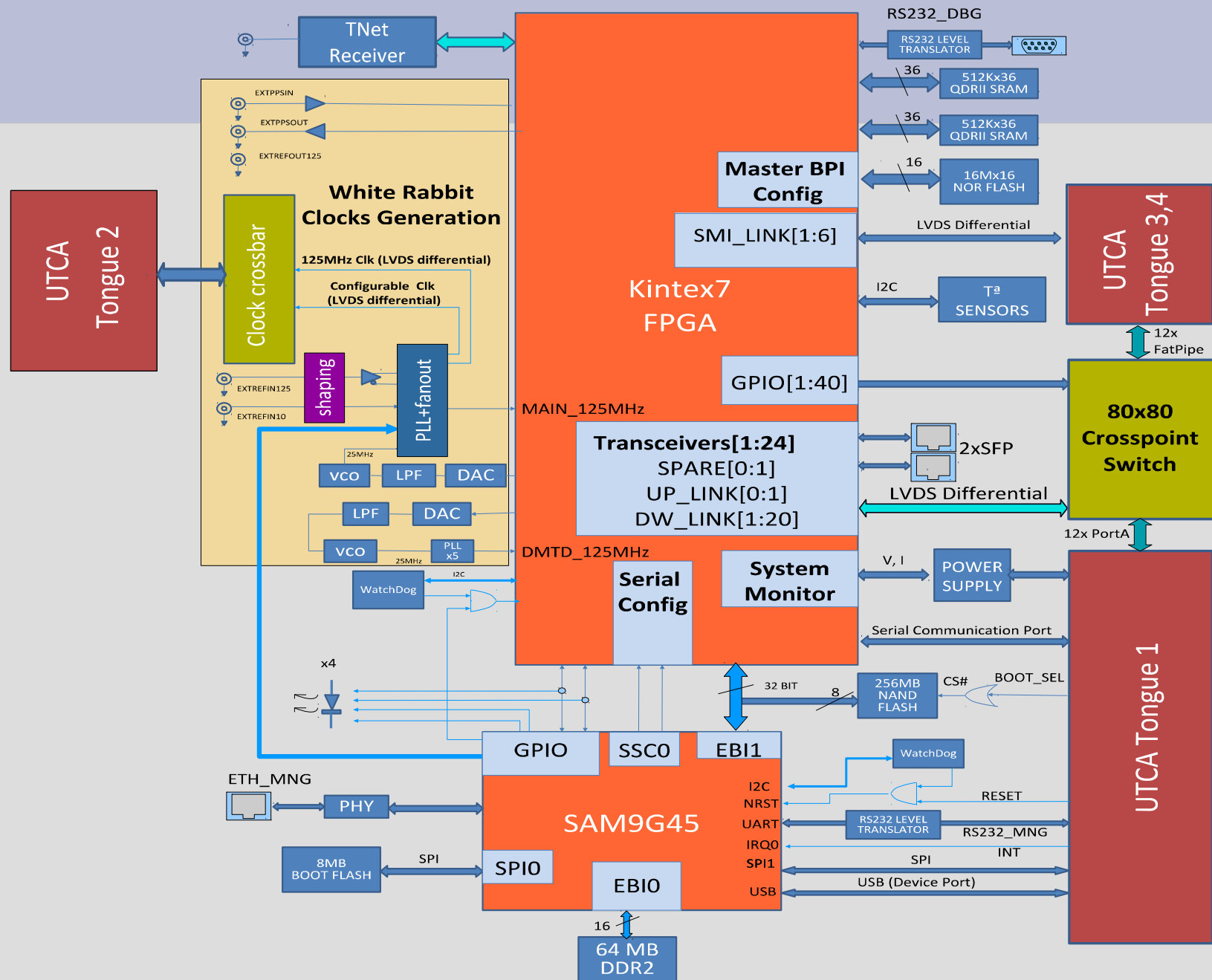


# MCH WR timing receiver/switch

- **Modified standard 18 port WR switch from OHWR**
- Additional Crosspoint Switch (crossbar)
- **Sub-ns accuracy ( $\sim 20\text{ps}$ ) over 1Gbit fiber**
- **Low jitter clock distribution based on crossbar with WR-RF synthesizer and PLL**
- Dedicated timing receiver connector
- **Integrated RF over WR synthesizer**
- Optional RTM-SFP
- Can be used as basic or redundant MCH
- Under development



# MCH WR timing receiver/switch





# Join Open Hardware community

