

DAQ Hardware Status

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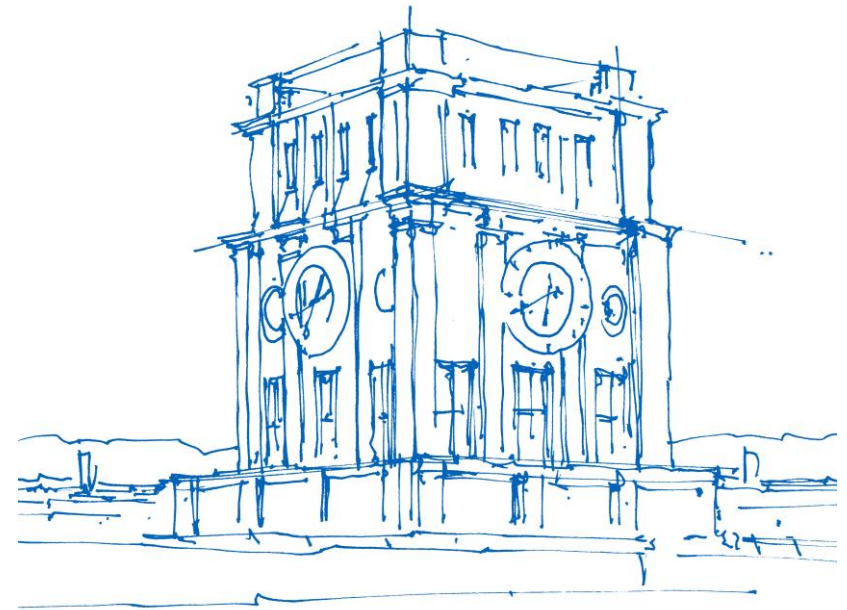
Institute for Hadronic Structure and Fundamental Symmetries (E18)

TUM Department of Physics

Technical University of Munich

COMPASS FETDAQ Workshop

CERN, March 2-3



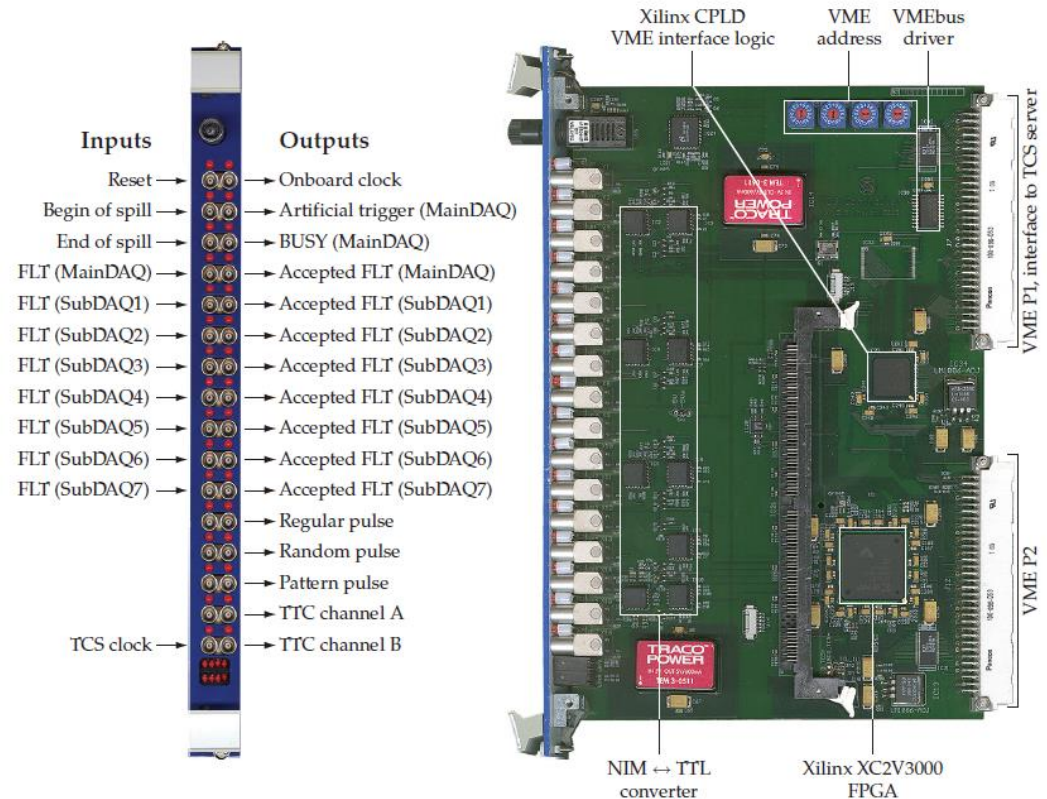
Uhrenturm der TUM

DAQ Modules

- TCS Controller
- Cross-switch
- DHmx/DHsw
- Xilinx Ultra Scale SDH
- Kintex 7 Spill Buffer PCIe (Stefan Huber talk)

TCS Controller

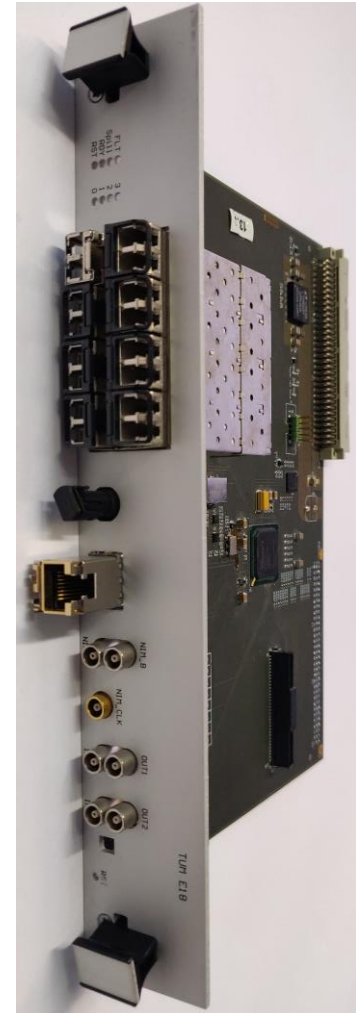
- TCS Controller
 - Time and trigger master of COMP
 - 155.52 MHz system clock
 - Virtex FPGA
- Prescaler firmware
- Developed in 2000



TCS for Standalone DAQ

- Spartan6-XC6SLX100T
- TCS firmware ported with small changes
 - IPBus for slow control
 - Optional internal SPS cycle generator
 - Internal Trigger generator
 - SPS SOB/EOB Inputs
 - Trigger input
 - Accepted trigger output
 - Maximum 8 destinations

- Still to be tested



New TCS Controller

- Based on iFTDC hardware, Artix7 FPGA
- TCS firmware ported
 - IPBus for slow control
 - Optional internal SPS cycle generator
 - Internal Trigger generator
 - SPS SOB/EOB Inputs
 - Trigger input
 - Accepted trigger output
 - Interface to TTC encoder, existing TCS system
 - 2 high speed inputs for trigger processor
 - 1 high speed TCS output, fanout by cross-point switch



DHmx/DHsw

- Backbone module of DAQ
- Firmware versions
 - Multiplexer with Slink interfaces
 - Switch with Slink interfaces
 - Multiplexer for iFTDC with UCF links
 - Full Bandwidth Switch (see Dima Levit talk)
 - Future: Multiplexer/SuperSw with UCF
- Supports Slink interface
- Will be migrated to UCF
- Production of 10 more modules completed in January



Cross-point Switch

Crosspoint Switch Components

○ interfaces:

- 12 x 12 channel CXP transceiver (MPO fiber connectors)
- Ethernet for IPbus
- JTAG
- TCS (Trigger Control System) receiver

○ Switching and Control:

- **Vitesse VSC3144-02** – fully configurable 144x144, asynchronous, 6.5 Gbps crosspoint switch
- **Xilinx Artix-7 FPGA** for switch control and monitoring



○ Interface FPGA – Crossswitch:

- 90 MHz, 11-bit parallel data bus
- Multiple program assignments can be queued and issued simultaneously \Rightarrow fast programming ($\ll 1\mu\text{s}$)

Cross-Point Switch Production

- Spare cross switch was given to Belle2
- 6 new switches produced in 2019 but
 - 3 modules with short circuits between +12V and GND
 - 1 module with problem to control cross-switch IC
 - The modules back to company for investigation
 - 2 modules passed first tests, high speed link tests still to be done

12G Cross-Switch

- We purchased 4 MACOM M21605G-12 switch ICs
 - Non-blocking, asynchronous 12.5 Gbps 160x160 switch
 - Fully configurable
 - Monitoring inputs and outputs
 - Advanced equalization circuit
-
- Module features
 - Kintex7 FPGA for control
 - FireFly 12x12G transceivers
 - TCS interface
 - IPBus interface
 - Full size ATCA card
-
- No estimation for completing development and production



iFDAQ XCKU095 Standalone Card

Kintex UltraScale XCKU095

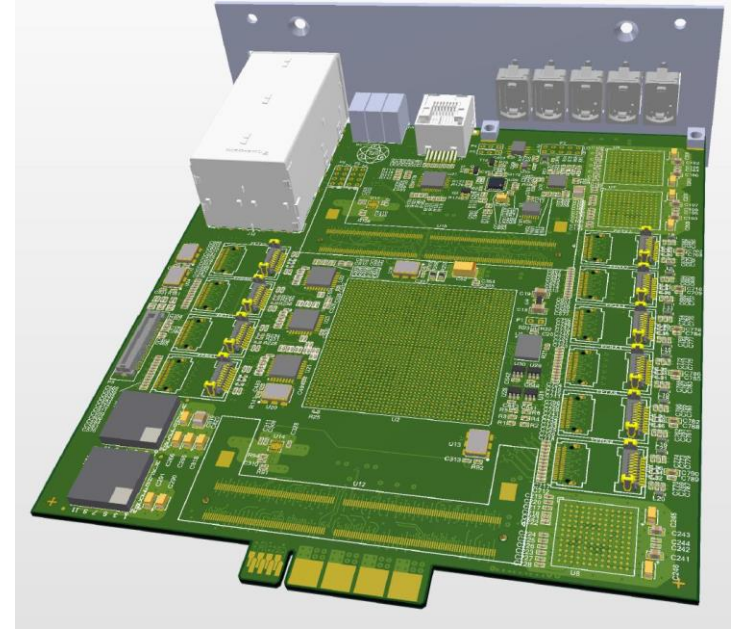
- 64 optical links (up to 16 Gb/s)
- 60 via MPO connectors
- 4 via SFP+ connector
- 2 DDR4 memory interfaces
- Up to 16 GB total storage
- Clock Jitter Cleaning

Known issues:

- Layers with high speed signals are not surrounded by GND/PWR planes – possible cross talk
- Mistake in foot print of DDR4 memory

Two cards delivered few month ago.

So far there was no time for tests.



iFDAQ XCKU095 Standalone Card

Kintex UltraScale XCKU095

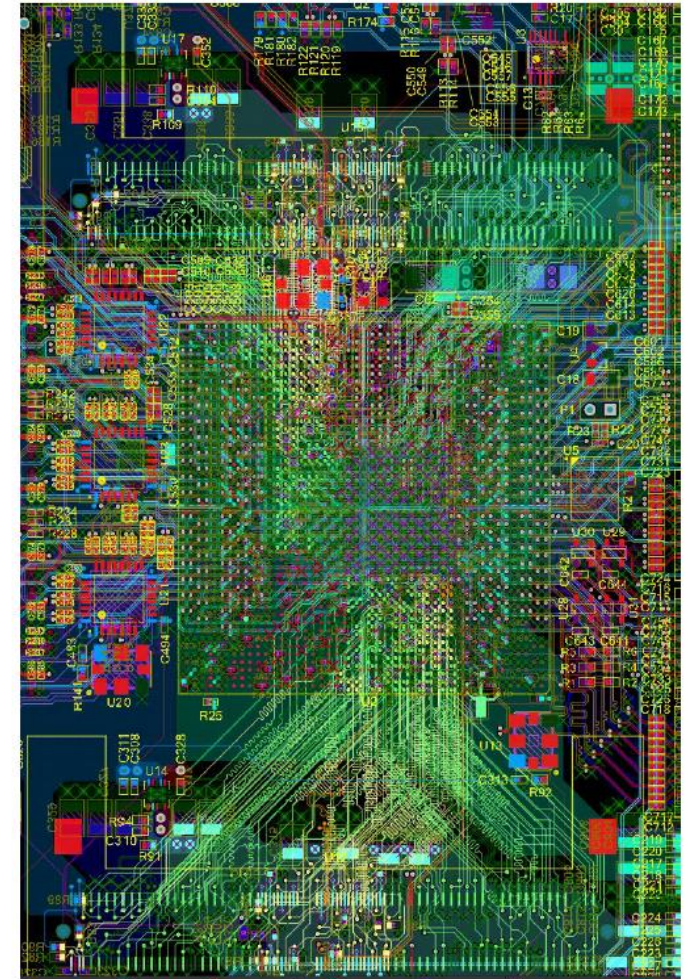
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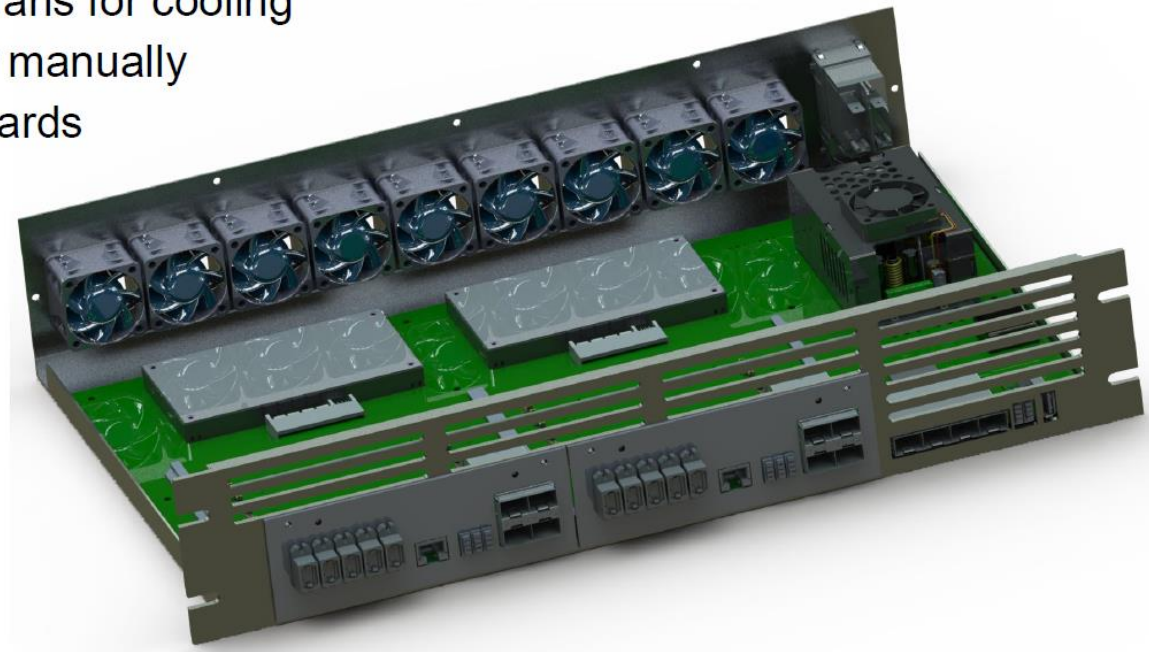
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iFDAQ XCKU Carrier Card

iFDAQ XCKU – Carrier

- 2U 19 inch rack box
- Holds two XCKU cards plus carrier
- 9 high power fans for cooling
- 3 switches for manually powering all cards

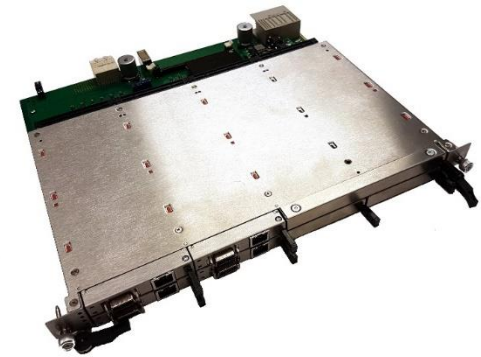
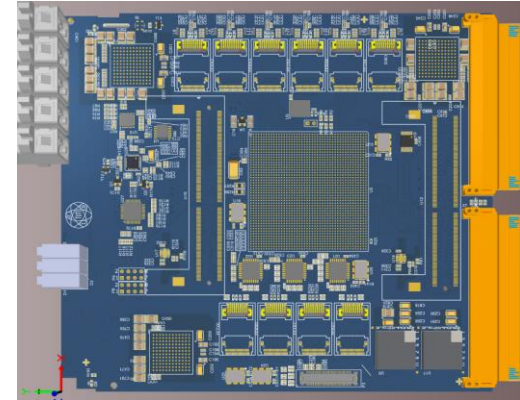


XCKU095 ATCA Card

Features:

- Double width ATCA module
- Fixed high speed links layout
- Changed DDR4 foot print

- ATCA carrier card



ATCA Shelf



Summary

- New generation of TCS controllers for standalone DAQ and free running DAQ are in progress and will be available within 1-2 month
- DHmx/DHsw will be main DAQ module for free running DAQ. Will be upgraded to UCF
- Problem with production of cross-switch modules, still two might be functional
- We plan to develop new 12G cross-switch using MACON21605 IC but no man power right now
- XCKU DAQ prototype module ready for tests and corrected version ATCA standard was prepared

THANK YOU