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# **The Common Data Acquisition Platform** in the Helmholtz Association

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Various German Helmholtz centers started in 2014 to develop a modular data acquisition platform. This platform integrates generic hardware components like the multi-purpose HGF-AMC Hardware or the UFO smart camera framework, adding user value with Linux drivers and board support packages. Technically the scope comprises FPGA-modules, frontendelectronics-interfaces, FPGA-microcontrollers plus software and high-performance data transmission to computing servers. The core idea is a generic and componentbased approach, satisfying specific requirements of different experiments.

# **Adopting New Crate Standards**

The HGF-AMC is an example of a versatile MTCA.4 FPGA board. Features:

- Powerful digital processing •
- Interface experiment-specific inputs via rear transition module (analog, ..)
- 4x 10 Gbit/s Ethernet readout links

#### Applications:

- Dark matter searches
- Ultrasound computer tomography



HGF-AMC and rear module for EDELWEISS

## **Rapid Development of FPGA and Microprocessor Firmware**

To cope with complex technologies libraries, building blocks and reference designs for common platforms enable reuse and reduce the required effort.

# Integration of "GPU Computing"

Integration of powerful parallel processing hardware is essential for modern DAQ systems. GPUs are rather compact and offer enormous performance that can be used for scientific computing. The UFO parallel processing framework simplifies programming and re-use of algorithms.



# UFO – A Smart Camera Platform

Toolbox to turn custom detectors in scientific cameras. Features:

- Compact readout board
- FMC front-end interface
- PCIe link with up to 6GB/s throughput
- Applications:
- Phase-Contrast-Tomography



for phase contrast X-ray

Zentrum Geesthacht

and KIT.

Analoo

front-end

tomography by Helmholtz-

"High-Flex" readout board

### Results

- Shorter development times for DAQ systems
- Maintenance and quality improves
- Double work is avoided

#### Example:

**Custom Analog Front-end** 

ambient conditions, ...)

Analog electronics often defines the

quality of the system. Interface to

standard and non-standard electronics (high-frequencies, low noise, extreme

> KALYPSO, a system using electro-optical modulation for monitoring of electron beams with femto-second time resolution.

#### Modules used:

- · Custom front-end board
- · UFO smart camera platform
- · Online data evaluation by GPU
- Effort: only about 1-2 FTE in ~1 year

In operation at 3 facilities: KIT, HZDR, DESY

ΔΝΚΔ



(Motherboard) FPGA-GPU data flow (traditional) Example of fast communication

by GPUdirect.

Partners in the Helmholtz Programme "Matter and Technologies":





High-throughput readout links are essential for heterogeneous FPGA-GPU systems.

Protocols and technologies:

- Ethernet PCI Express
- Infiniband
- RDMA (e.g. GPUdirect)
- . . .

