Image Acquisition and Processing with MicroTCA.4

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Agenda

- Image Acquisition System
- Examples of Image Acquisition Systems
- Image Acquisition build with MTCA.4
- Image Acquisition and Processing
- Conclusions

Image Acquisition System

Video Camera | **Frame Grabber** | **Data Acquisition and Processing**

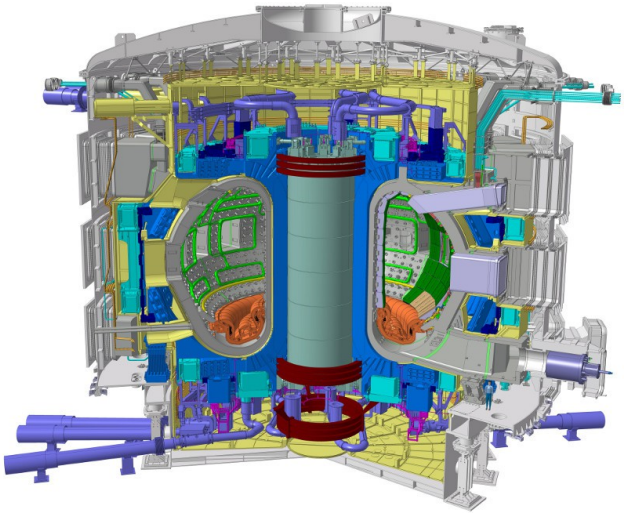
Challenges:

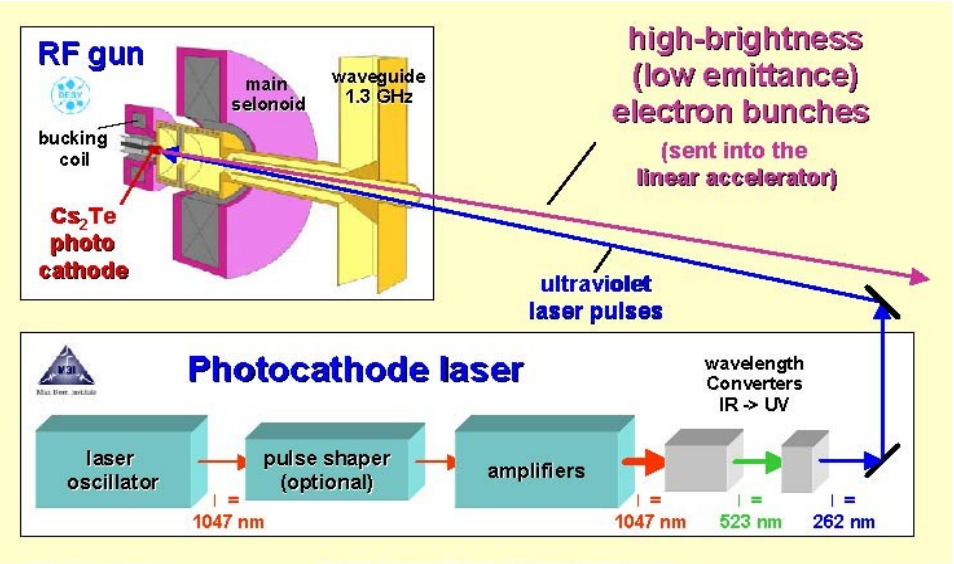
- High reliability, industrial form-factor
- Streaming and processing from multiple cameras
- Synchronization, timestamping

Examples of Image Acquisition System

Image Diagnostics:

- ITER – plasma diagnostics
- DESY FLASH/XFEL – photoinjector pulse diagnostics
- DESY REGAE – Center for Free-Electron Laser Science accelerator R&D





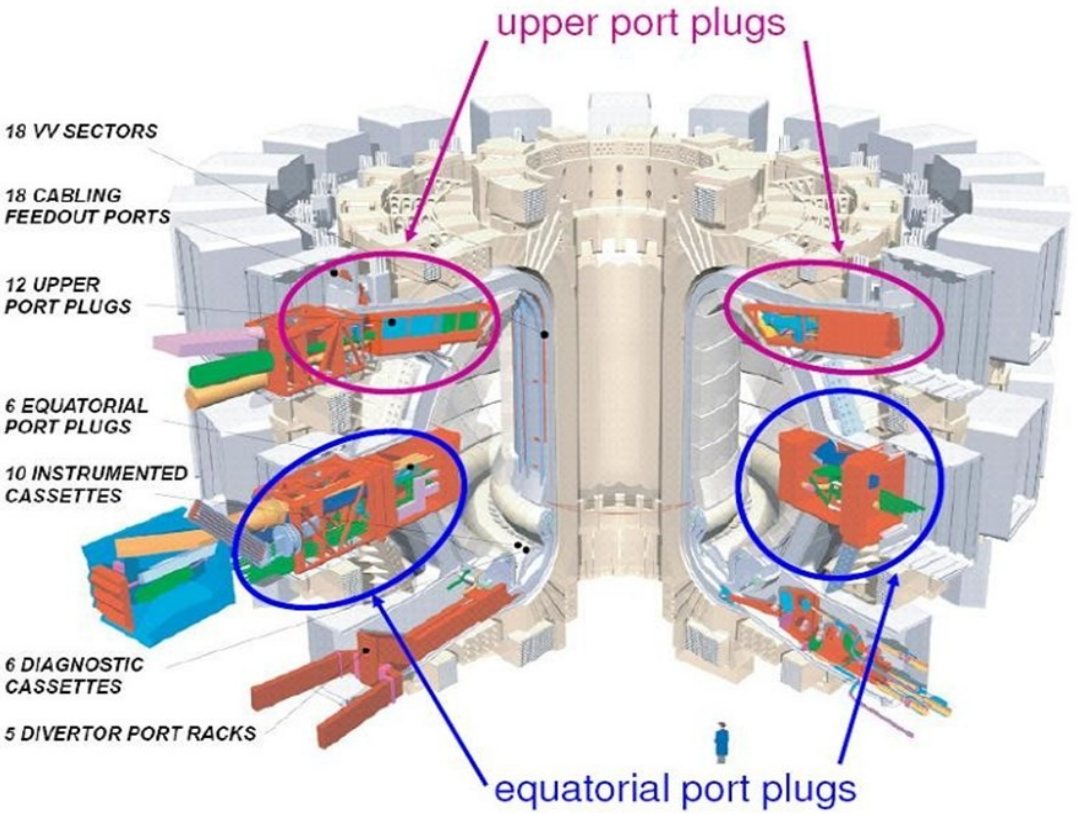
Source: https://www.mbi-berlin.de/

ITER Project

Challenges in design of imaging systems for plasma diagnostics:

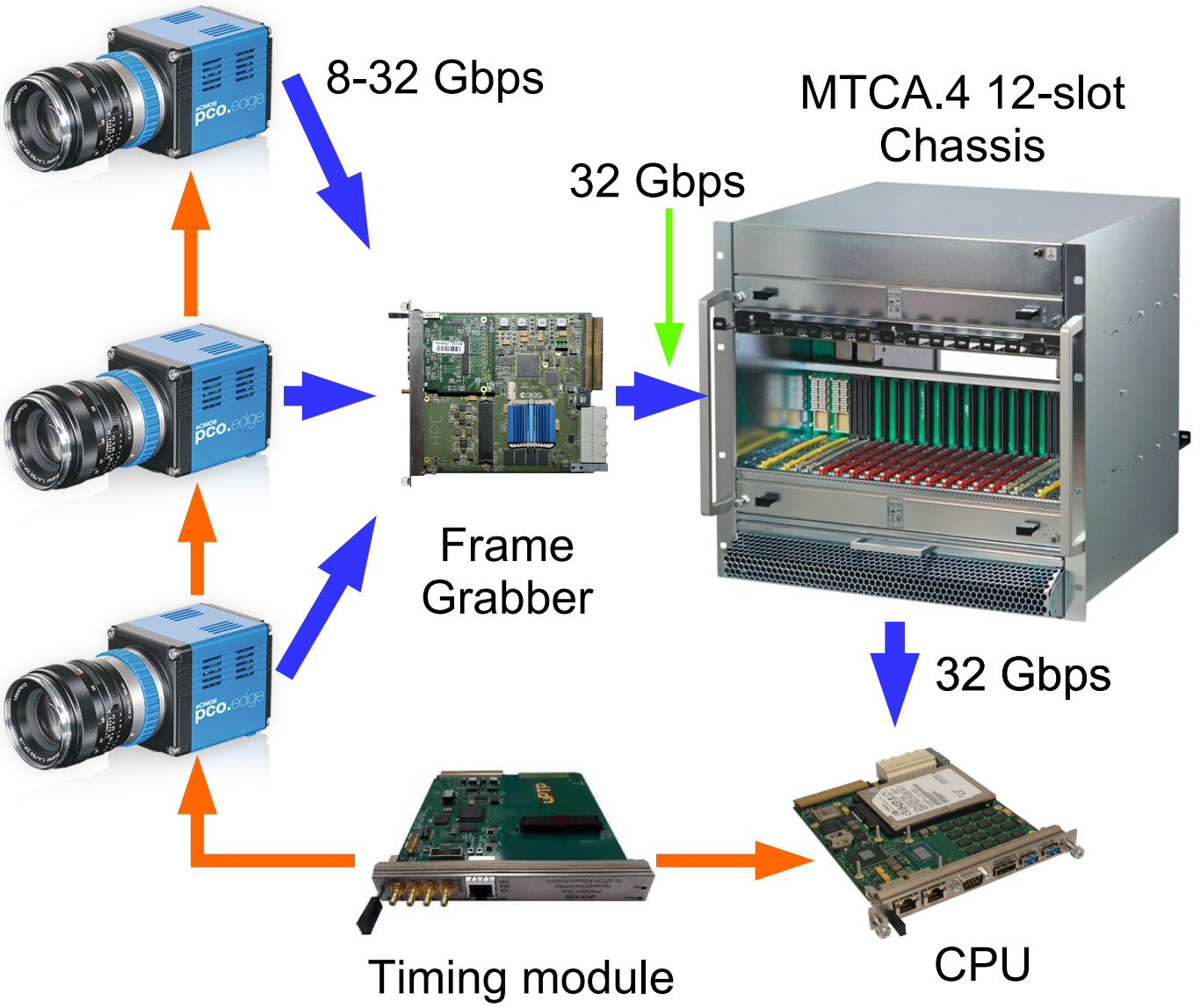
- Plasma diagnostics - monitor plasma temperature, density, radiative properties, first-wall resilience
- 200 cameras:

  1-8 Mpx @ 50-50000 FPS
- Throughput can easily exceed 8 Gb/s per camera
- Scalability and high reliability
- 50 ns synchronization accuracy



ITER Diagnostic Port Plugs

Image Acquisition and Processing with MTCA.4



Micro Telecommunication Computing Architecture:

- High RAMI (Reliability, Availability, Maintainability and Inspectability)
- Extensions for precision timing and synchronization
- Intelligent Platform Management
- Good price to performance ratio

Image Acquisition and Processing with MTCA.4

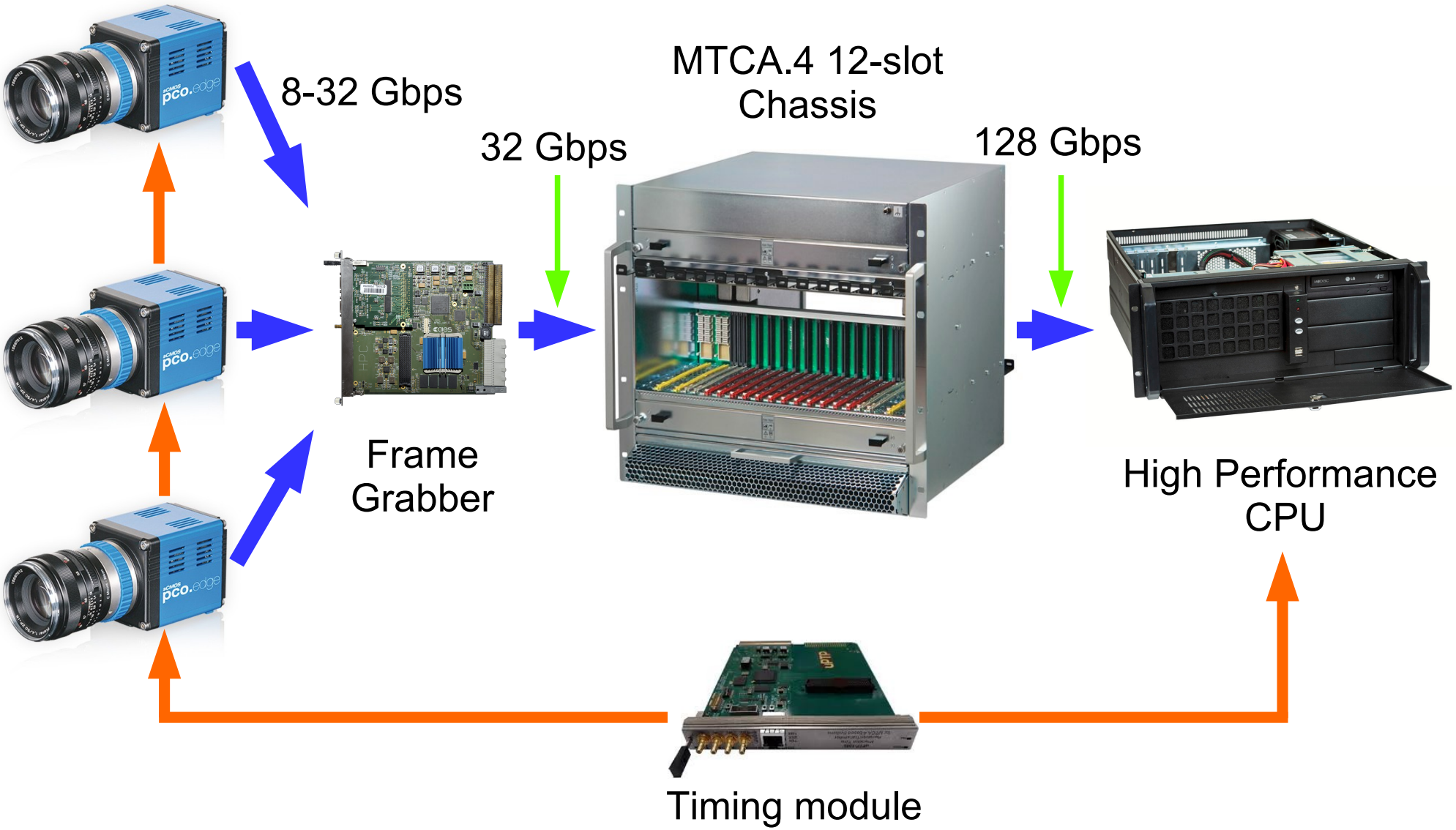
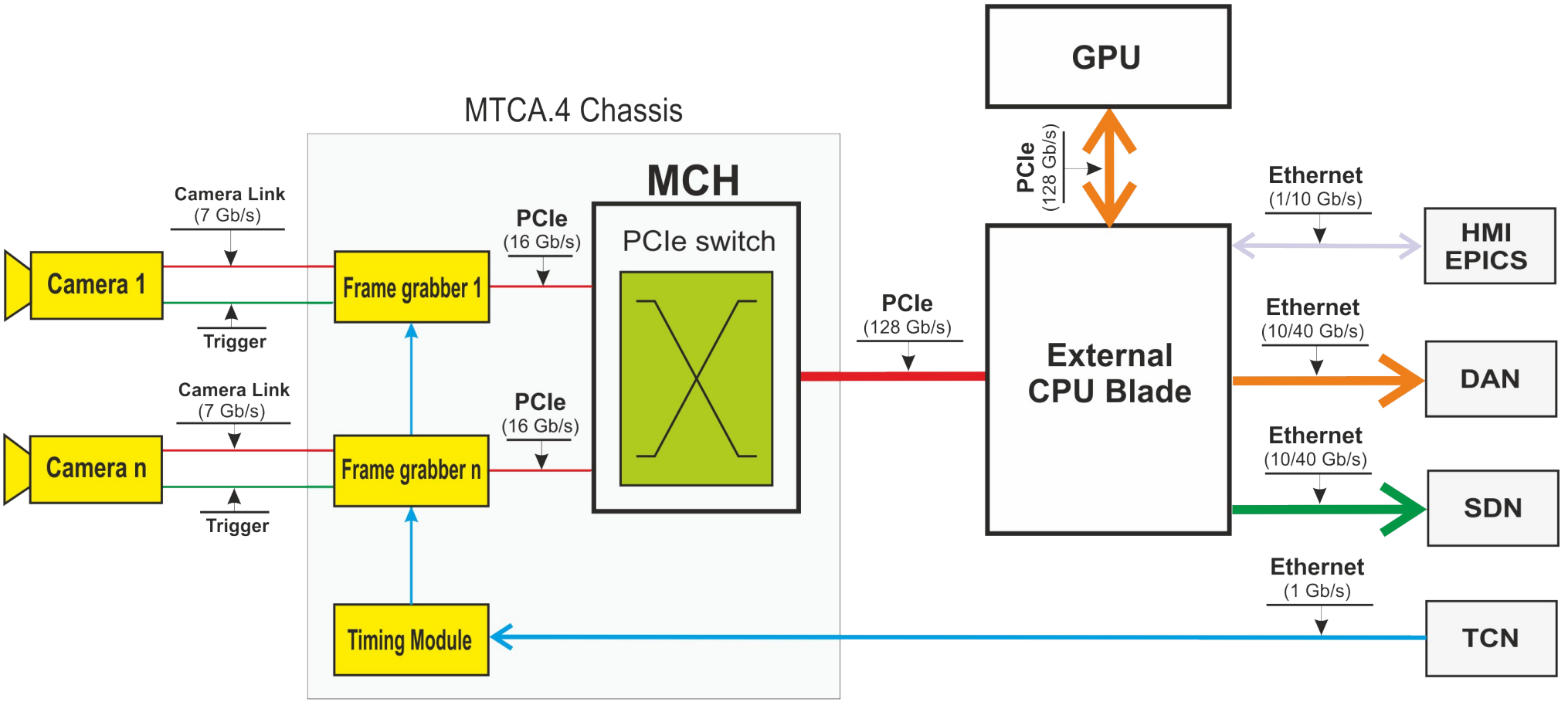
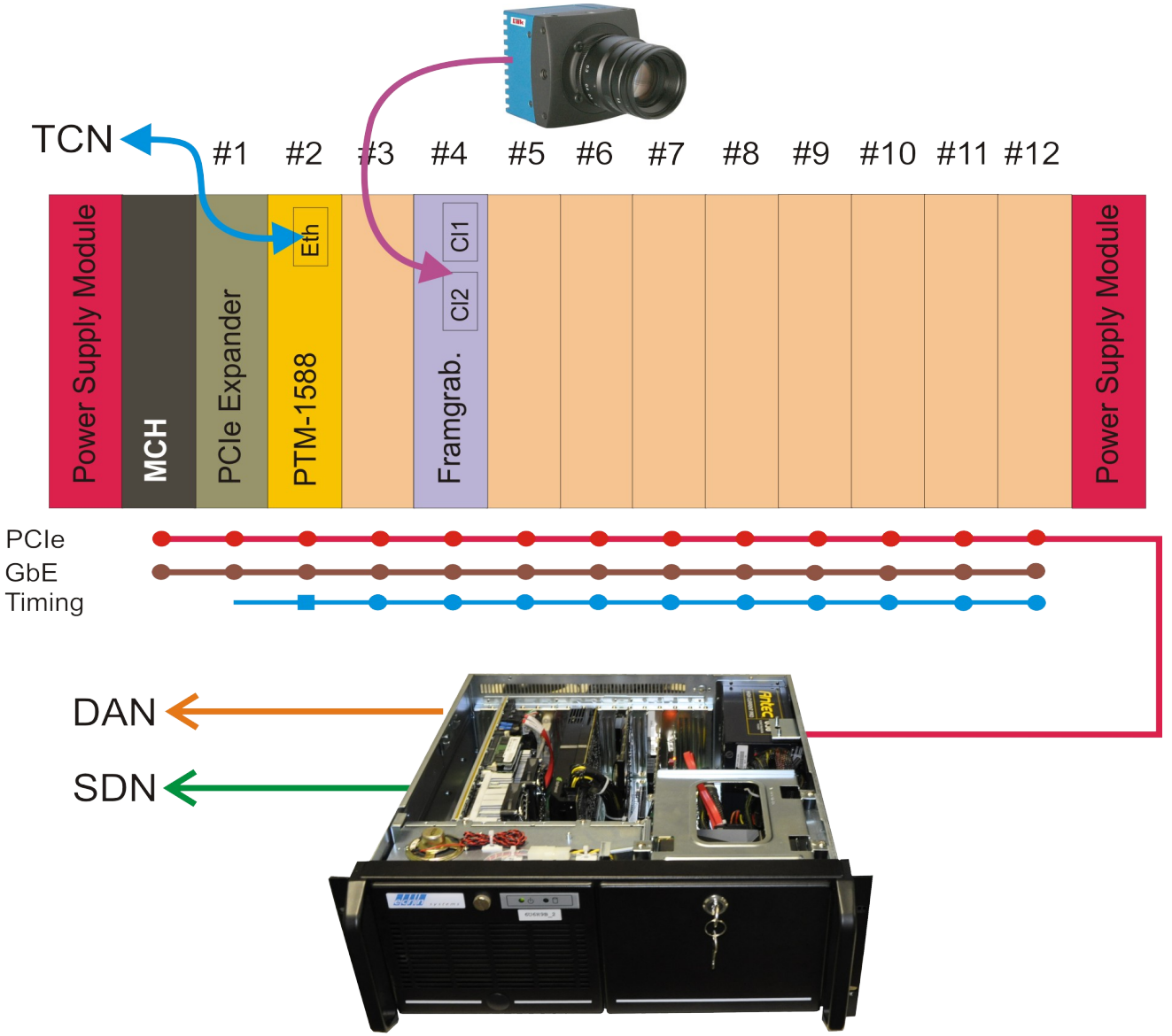


Image Acquisition – External CPU



MTCA.4-based Image Acquisition System



Various Cameras and Interface Standards

Various interfaces for cameras:

- Camera Link
- Camera Link-HS
- CoaXPress
- GigaVision
- IEEE1394b/Fire Wire

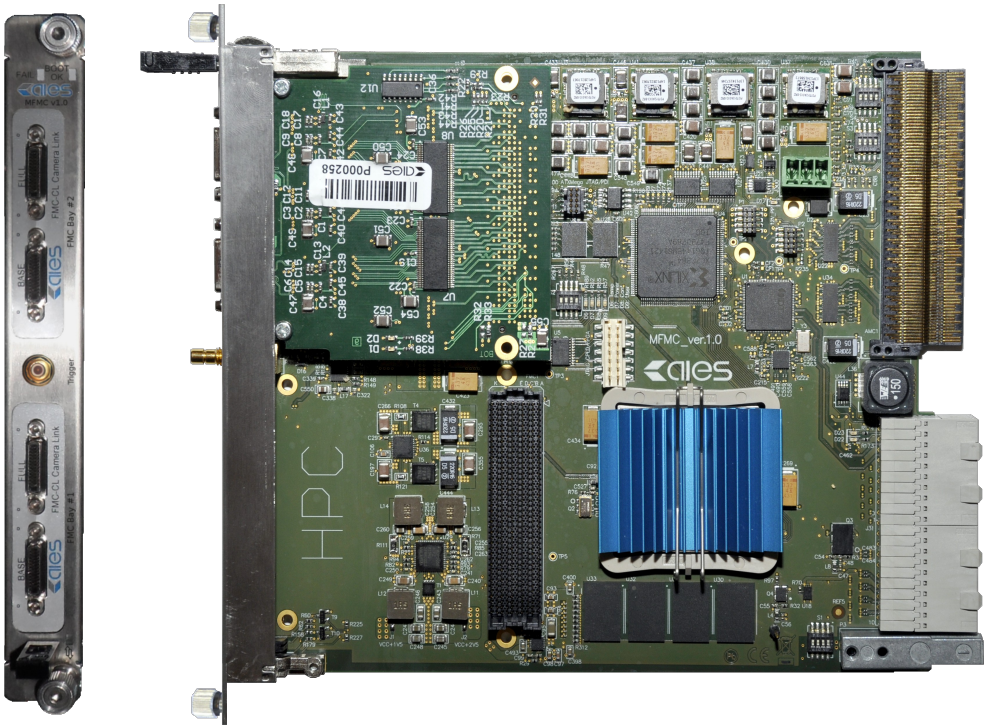
Mikrotron MC3010/3011

PCO Edge 5.5

Andor Neo 5.5

MFG4 - Frame Grabber Card for MTCA.4

- Cost-effective solution for high-performance image acquisition systems
- Designed as FMC carrier module (HPC and LPC) with FMC extension modules:
  - Camera Link (Base, Full, Ext-Full)
  - CoaXPress
  - Universal IO module
  - Firmware support for selected protocols
- Provides all resources for data acquisition and control systems (FPGA processing power, SDRAM, clocks distribution, trigger and interlock signals)
- Based on Xilinx Artix 7 (XC7A200T) FPGA
- RTM Zone 3 connector (D1.2 Digital Class)



MPCIE-16 - PCIe Link for MTCA.4

- Allows to overcome the limitations of MTCA.4 PCIe connectivity
- More processing power using external CPU
- Possibility to use powerful GPU
- Supports PCIe x16, gen. 3 via copper cable
- Data throughput up to 128 Gbps
- Cost effective solution for MTCA.4 System
- No additional drivers or software needed

Image Acquisition System - Firmware

- Three paths for image, camera control and triggering
- Allows acquiring image from CL camera
- Powerful DMA over PCIe
- AXI Stream interface to CL receiver

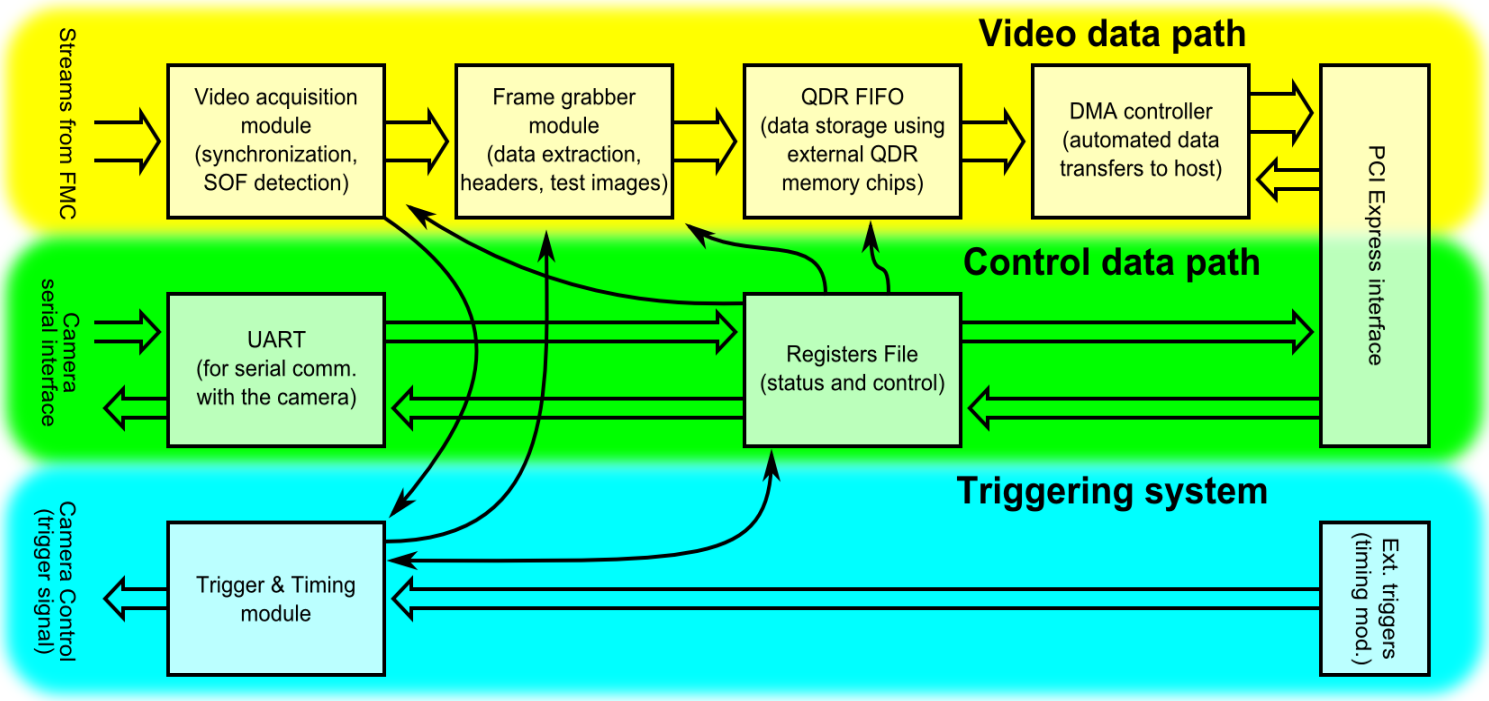


Image Acquisition and Processing Firmware

Image Acquisition System - Software

- API for EPICS, DOOCS and QT
- Library for 3 cameras:
  - Microtron
  - PCO
  - Andor
- Available nodes:
  - Frame Grabber
  - Camera control
  - Camera image
- Linux driver and NDS library
- HMI panels

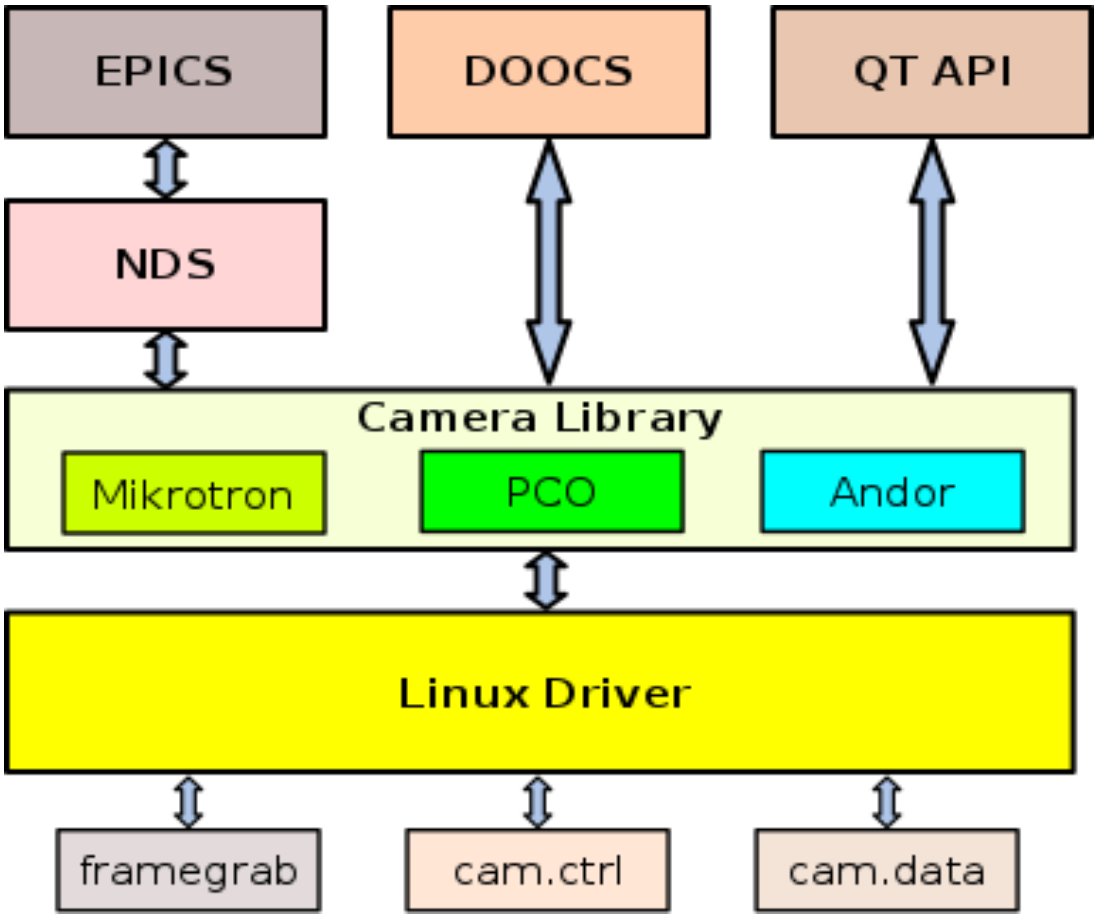
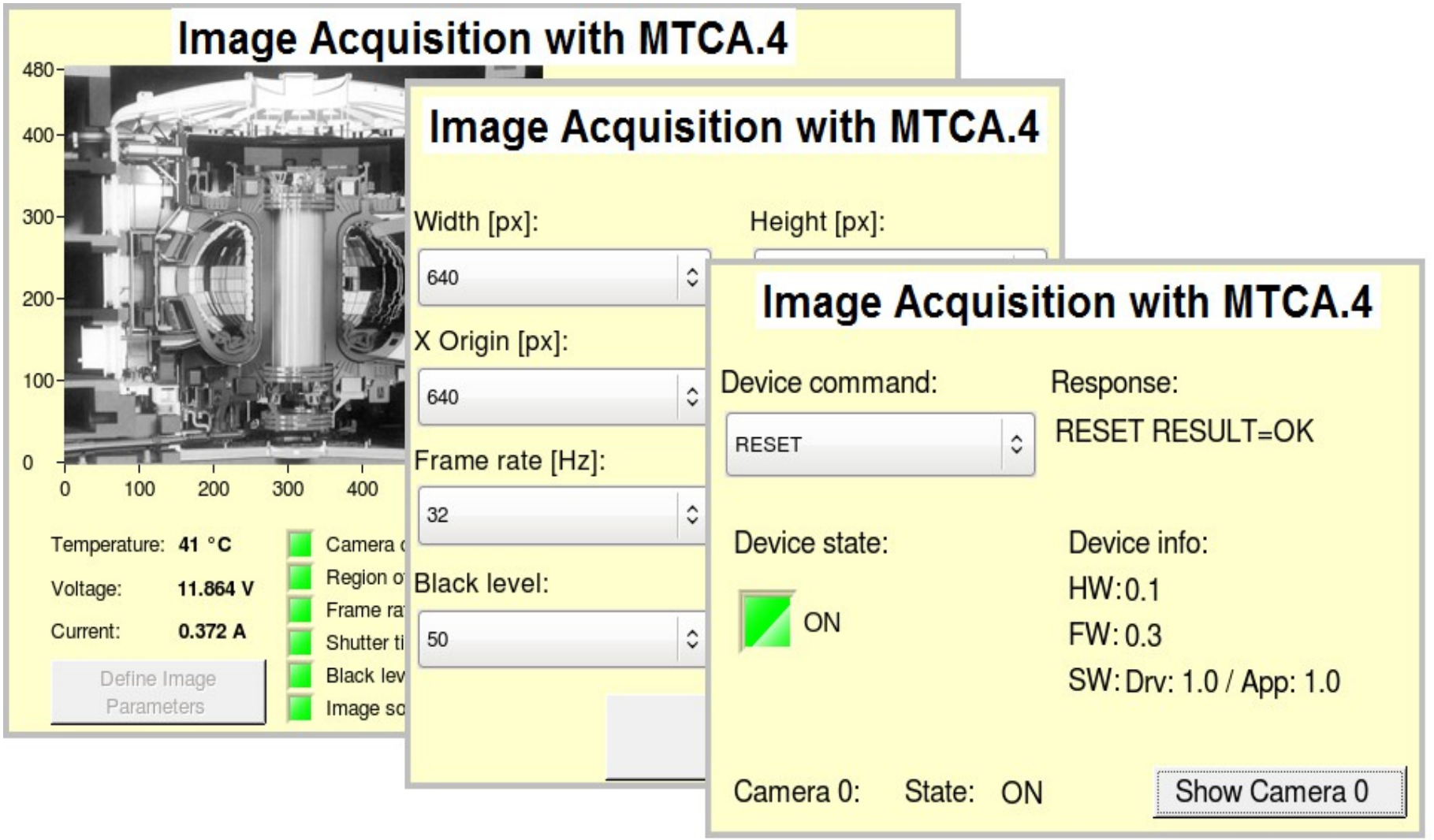


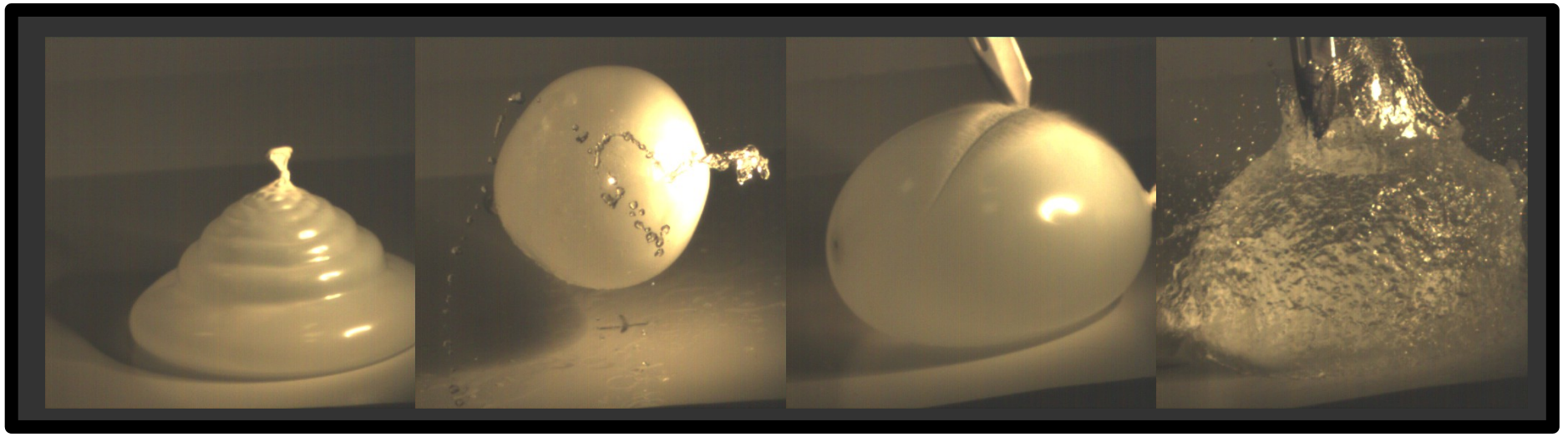
Image Acquisition – EPICS Panels



Summary

- Powerful image acquisition and processing system based on MTCA.4 system
- AMC frame grabber card with support for Camera (CL Full-Extended)
- IEEE 1588 timing module
- External high-performance industrial CPU with PCIE x16, gen. 3, GPU, DAN/SDN

Enjoy the working system:



Thank you for your attention