PAUL SCHERRER INSTITUT

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Bernd Schmitt :: Photon Science Detector Group :: Paul Scherrer Institut

Detector Toolbox

On behalf of the Detector Working Group

LeapsIT meeting, Mai 13 2019, Paul Scherrer Institut

Objectives of Detector Toolbox

A detector is a very complex system using many technologies and cost lot of effort (human resources, time and funds). A single detector development has only a limited impact. All pixel detectors have similar blocks/components

- A detector toolbox allows to quickly adapt/develop a detector with new requirements -> much larger impact than any single detector development

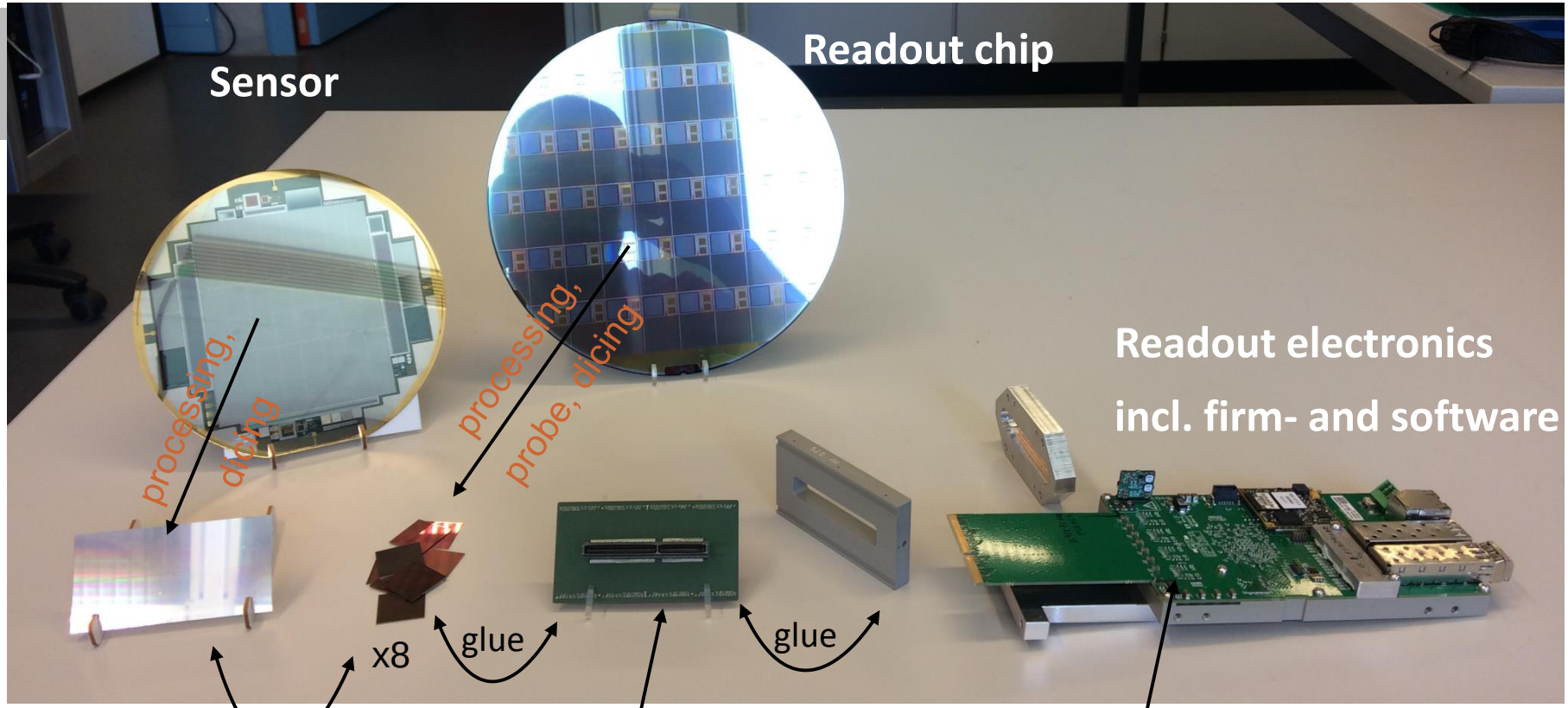
Objectives:

- Develop detector 'building blocks' reaching from the ASIC to readout electronics, firmware and software up to the file on disk (including data backend)
- Helps in standardization of detectors, readout systems and data backend systems
- Helps in establishing a common architecture for high speed data backend systems
  - Helps in increasing portability of the detector systems

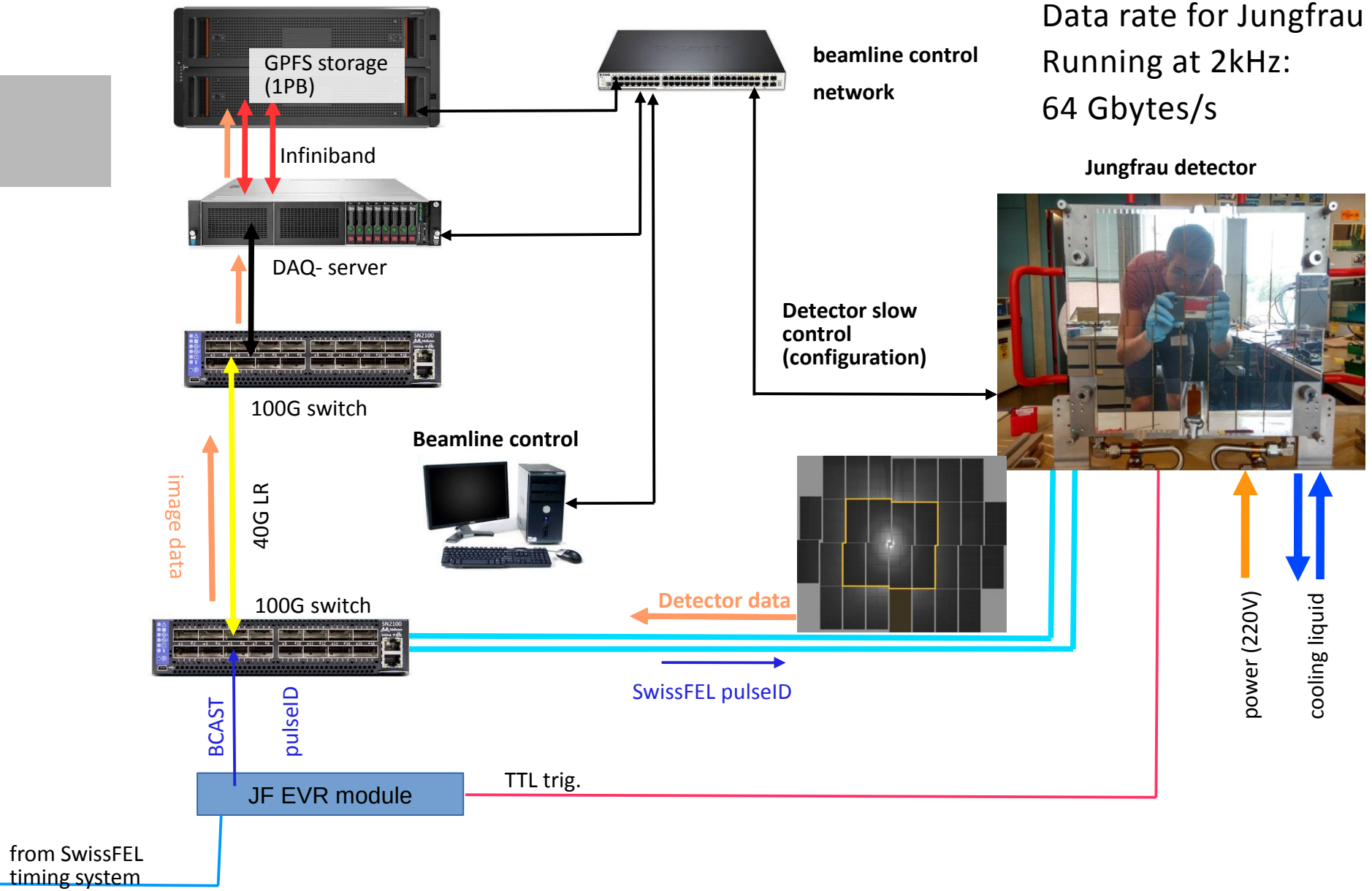
Benefits:

- Reduction of global effort for new developments
- Increase and diffuse know-how among Facilities
- Impact in detector development for many years in photon science

Detector components (example Jungfrau)



Detector readout system (example Jungfrau)



Detector toolbox

Modular building blocks for ASIC, readout system (firmware and software) and data backend (hardware and software)

On the ASIC side:

- Standard interface for configuration
- ADCs and DACs
- High speed data link to FPGA

Readout board:

- Talk to ASIC:
  - Implementation of a readout board with firmware and software, for configuration, operation and data transfer to/from ASIC (requires to match the ASIC standard)
- Talk to data backend:
  - Complete implementation of data transfer firmware to data backend system (requires to match the data backend standard)

Data backend:

- Development of building blocks for a scalable (in terms of detector size and framerate/data rate) data backend system
- Development of one implementation including hardware and software

Description of work/Main goals of pilot phase

Complete toolbox will take several years and will be used in development of LEAPS detectors

Main Goals of Pilot Phase:

- Definition of the Toolbox, it's structure, the way it will operate and be managed
- Focus on the Asics and interfaces to the Data acquisition and back-end systems

Four phases

- Phase 1: architectures and mode of operation will be defined by all LEAPS partners. IP related issues will be sorted out. Investigation of the possibility of a joint WG1-WG3 project on DAQ for high-data rate detectors.
- Phase 2: ASIC building blocks definition (including slow control interface with the ASICs, high speed data transmission links to FPGAs and other blocks)
- Phase 3: ASIC building blocks design in parallel at DESY and PSI for different CMOS processes. ASICS prototypes will be fabricated
- Phase 4: tests and characterization of prototypes → feedback for LEAPS main phase

Distribution of work

Pilot Phase Duration				36 months				
Participant	DLS	SOL	DESY	PSI	ESRF	ALBA	ELET.	Total
Person-months	12/6	12/6	72/36	72/36	12/6	12/6	12/6	204/102

Participant	Task 1 Def of blocks	Task 2 Chip Design	Task 3 Chip Testing	Total person months
PSI	X	X	X	36
DESY	X	X	X	36
ESRF	X			6
SOLEIL	X		X	6
ALBA	X			6
ELETTRA	X		X	6
Diamond	X		X	6
Total				102

Collaboration Leaps Detectors and IT

GOAL from Detector side:

- Development of a toolbox from Sensor to file on disk

Current Detectors can produce close to 100 Gbyte/s

Future Detectors will get close to 1TByte/s

Detectors and data backend not independent
Common approach/Toolbox required

- Between LEAPS Detectors and LEAPS IT
- And between Facilities in general

It is important that we start to talk and that the data backend becomes a part of LEAPS IT

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How do we continue?

Wir schaffen Wissen – heute für morgen