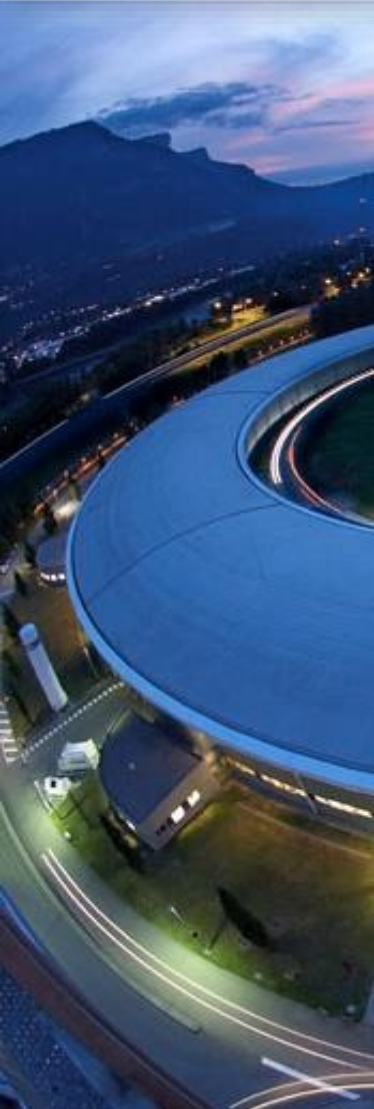




The European Synchrotron



RASHPA:

A generic RDMA-based distributed DAQ framework for high-throughput X-ray detectors

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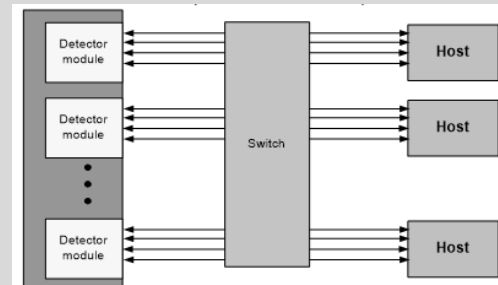
on behalf of W Mansour, A Bideaud, P Fajardo and many other ESRF staff

THE NEED OF DISTRIBUTED DETECTOR DATA ACQUISITION

- High performance **multimodule detectors** and high data bandwidth **routable connections** can produce and deliver huge throughput data streams.
- Next generation of detectors: **~100 GB/s/Mpixel**
- Main challenge is not to send the data, but to **receive** them !!

Need of a convenient scheme for distributing the first data acquisition layer across multiple nodes combining:

- Performance:
 - **Multi-module to multi-receiver capable architecture**
 - **Simultaneous parallel data-flows**
 - Zero copy data transfer – Minimum CPU processing of data
The detector is the master: it writes data directly into the final destination data buffers
 - Facilitate data management & low latency processing
 - Compatible with existing and future high performance data links
- Flexibility and scalability for a given detector
- **Standardisation & reusability**
- Ease of use





- High performance data **transfer architecture from the detectors** (hardware and low-level software)
- Enable and facilitate advanced parallel on-line processing
 - Highly **configurable**: source and destination selection, data dispatching rules, ...
 - Multiple **simultaneous data streams**: data storage, low-latency (ms) processing, display, ... / Full frames – partial frames – subsampled frames
- Data is pushed into destination by **RDMA** (Remote Direct Memory Access) without software intervention
 - Support for both PCIe and RoCEv2 (100GbE) data transfers
 - Able to push data into the memory buffers of **GPU or FPGA** processors with millisecond latencies
- To be integrated in **new detector developments** and applicable to certain existing non RASHPA modular detectors



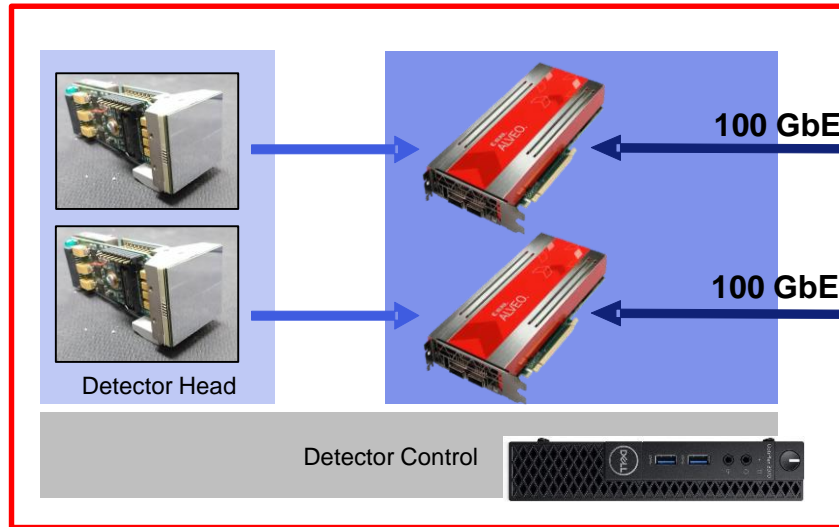
→ Complemented by **LIMA2**

- New high-level software framework for 2D detector control and data acquisition
- Distributed version of LIMA, Open-source, available on ESRF's Gitlab instance

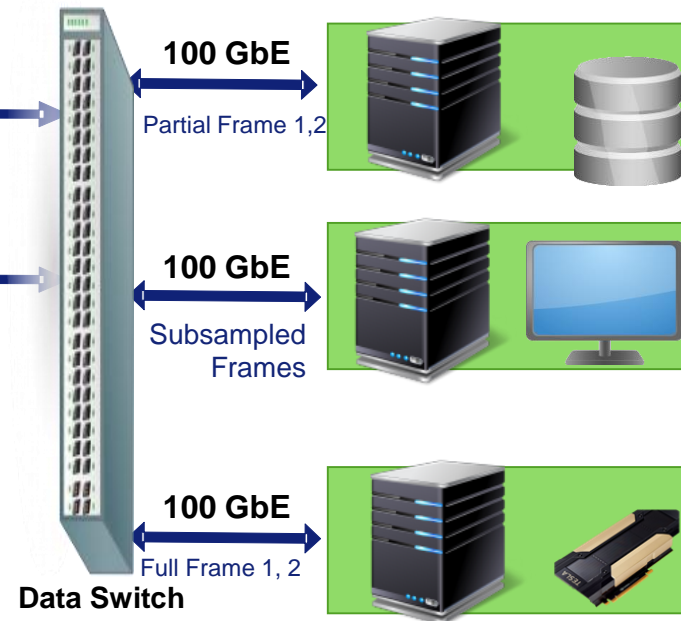
FIRST RASHPA QUALIFIED DETECTOR: SMARTPIX 1M

- **SMARTPIX**: a Medipix 3 based modular detector
- Complete architecture implemented using **RoCEv2** with **100 GbE** data links

DETECTOR: 1M SMARTPIX



DATA RECEIVERS - scalable SYSTEM MANAGER



RASHPA components: FPGA firmware and embedded detector software, backend library (libRASHPA)

COTS components: ALVEO boards (FPGA), 100 GbE switch and NICs, control and data receiver computers, FO cabling, ...

SUMMARY AND OUTLOOK

- **RASHPA**, an advanced **distributed** data acquisition framework for 2D X-ray Detectors has been developed at the ESRF
- **RASHPA** is a generic framework, not limited to one specific detector
- The concept has been demonstrated and the first full implementation with RoCEv2 on 100 GbE has been integrated in the **SMARTPIX 1M** detector.
- **LIMA2**, a distributed version of LIMA, the ESRF standard detector and data acquisition software, is also under advanced stage of development.
- Further validation of **RASHPA** with more complex configurations is ongoing and the first tests at a beamline are planned for the coming months.

THANK YOU FOR YOUR ATTENTION !

