High-Speed 2D Detector DAQ at the ESRF

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Extremely Brilliant Source

The ESRF EBS upgrade has mean a tremendous increase in X-ray photon flux at the experimental beamlines. Faster measurements and more advanced techniques allow access to **brand new science**.

BLISS BL control system

The new BLISS software brings instrument control and DAQ to a new level by joining the step-by-step and continuous scans with a single controller API. Fast experiments are now **much easier**.

Faster X-ray detectors

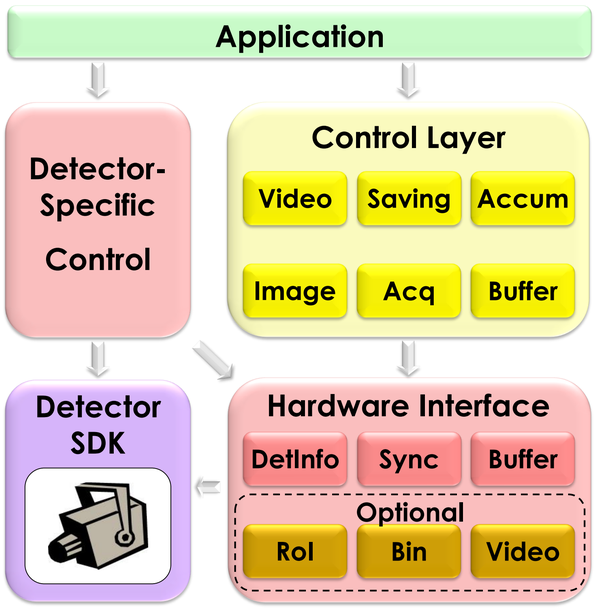
High Performance 2D Detectors **keep growing** in size and frame rate. DAQ and data processing becomes more and more challenging, requiring in some cases more than one backend computer.

More demanding ODR

Online Data Reduction (ODR) becomes more sophisticated in order to provide richer on-the-fly information on the ongoing scans. Scientists can **sooner** define the **best measurement strategy**.

LImA: a Library for Image Acquisition

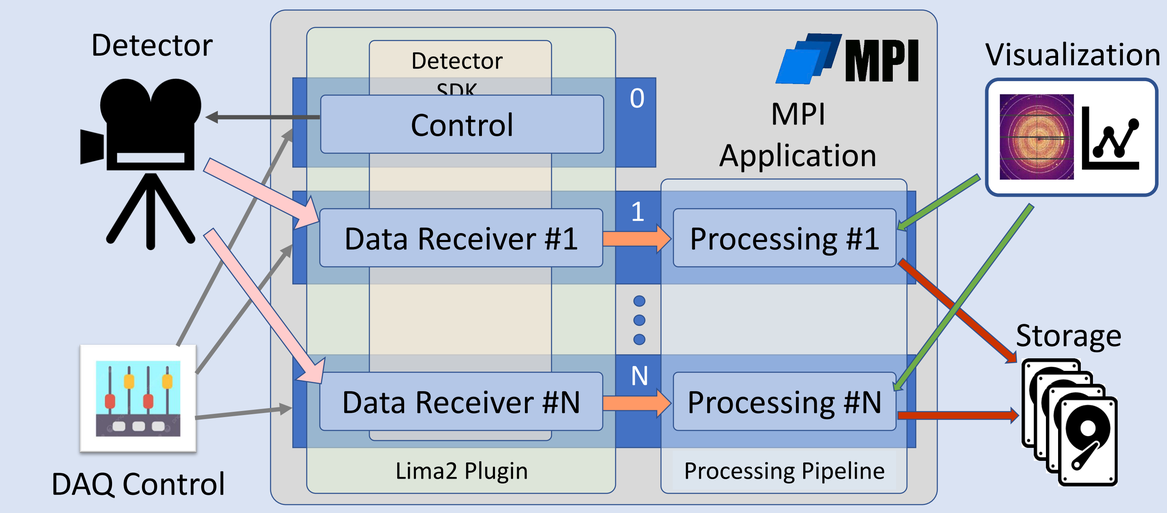
developed to unify the control and DAQ of fast 2D detectors, LImA has been used for about **15 years** in several facilities



- Geometry & intensity correction
- Soft Binning/RoI/Flip/Rotation
- Frame **accumulation**
- Pixel **mask**, background subtraction, flat-field correction
- Visualisation & video
- **ODR**: statistics in rect./arc RoIs, X/Y projection (RoI-2-spectrum)
- **Saving** into common file formats including **compression**
- Fast storage for **ODA**

LImA2: scalable solution for 2D detector DAQ

a Distributed C++ MPI application consisting in one control process and multiple data receivers

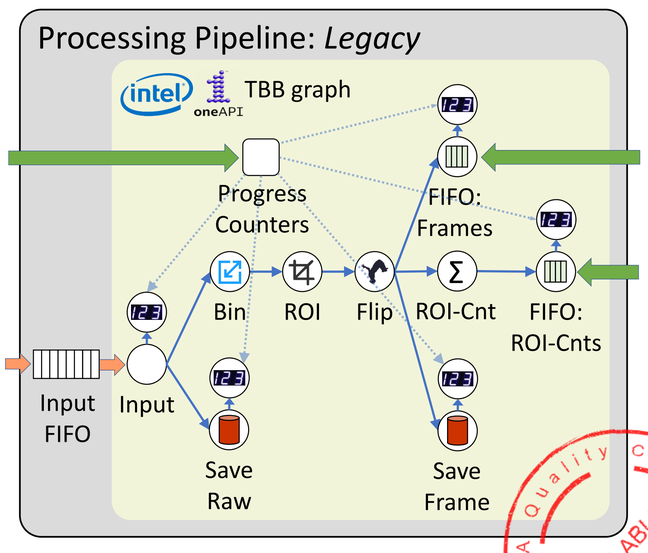


LImA supported camera plugins: 44 (active: 32)

multiple detectors integrated into LImA, most in production

LImA2 Processing Graphs with OneAPI TBB

- Specific & optimised pipelines
- Flexible design for **low-latency** ODR



XPCS pipeline featuring sparsification

- In production @ ID10
- First integration into **BLISS** scanning engine
- **x100 speed-up** in file read

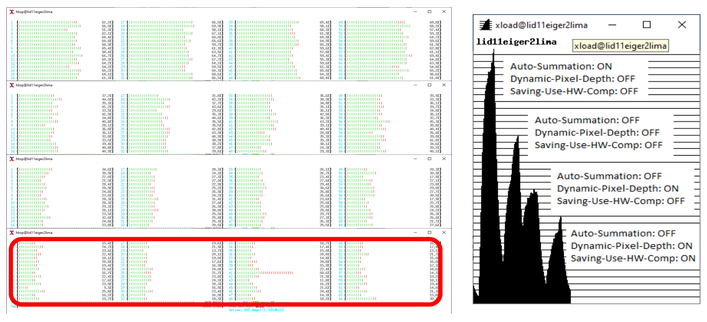
Dectris/Eiger2 supported in LImA2

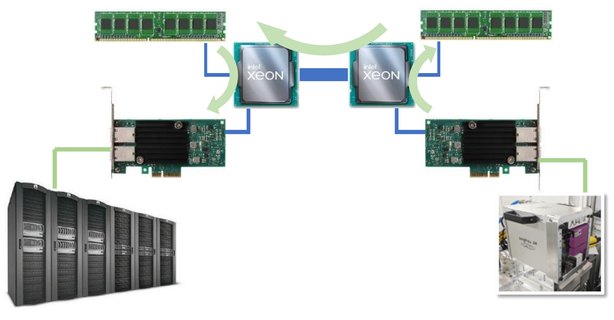
- Uses **STREAM2** protocol
- Dual-threshold feature integrated as multi-band frames
- Can dispatch data to **multiple receiver backends**

LImA recent developments: the kilo-Hertz regime

core keeps being optimised for high data throughput

- New **accumulation** features
- Frame binary **sideband** data
- Improved saving performance
- Can use **compressed image** from Dectris/Eiger DCU
- Free CPUs for **processing**

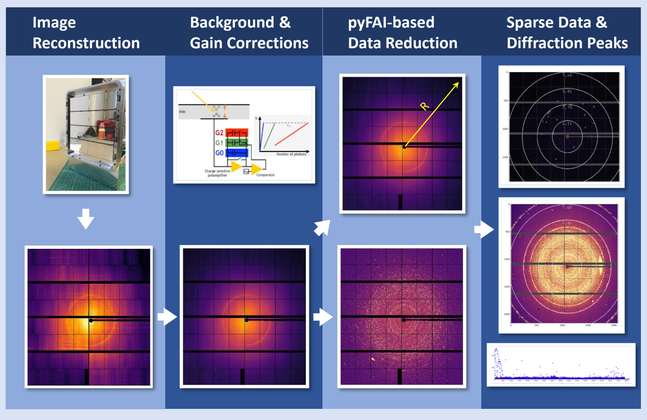




- NUMA & CPU affinity control
- Ensure critical task **scheduling**
- Pre-allocate auxiliary buffers
- Optimise data flow @ **4 GByte/s**
- PSI/Eiger-500k: 4-bit @ **8 kHz**
- PSI/Jungfrau-1M @ **1 kHz**

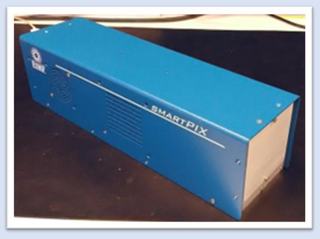
LImA2 for Serial MX with PSI/Jungfrau 4M on GPU

The ID29 Serial MX ODR uses **pyFAI Peakfinder** on 2x computers to determine *no-hit* events, which are eventually **discarded**. Sparse images and diffraction peak list are saved and **displayed online**.



ESRF Smartpix & Rashpa Medipix3 RDMA+GPU direct

The ESRF/Smartpix detector integrates Rashpa, a powerful, versatile and scalable platform providing high-speed data transfer to CPU & GPU memory using the **RoCEv2** technology.



With latency times as low as **1 ms**, the system targets **active feedback** in X-ray experiments.

https://github.com/esrf-bliss/Lima

https://limagroup.gitlab-pages.esrf.fr/lima2/