Distributed Acquisitions systems

A software solution

On behalf of :

- Florent LANGLOIS
- Arafat NOUREDDINE (MEDIANE)
- Stéphane POIRIER
- Clément RODRIGUEZ (ALTEN)

- Scientific requirements and scope of the project
- Technical description of our software solutions
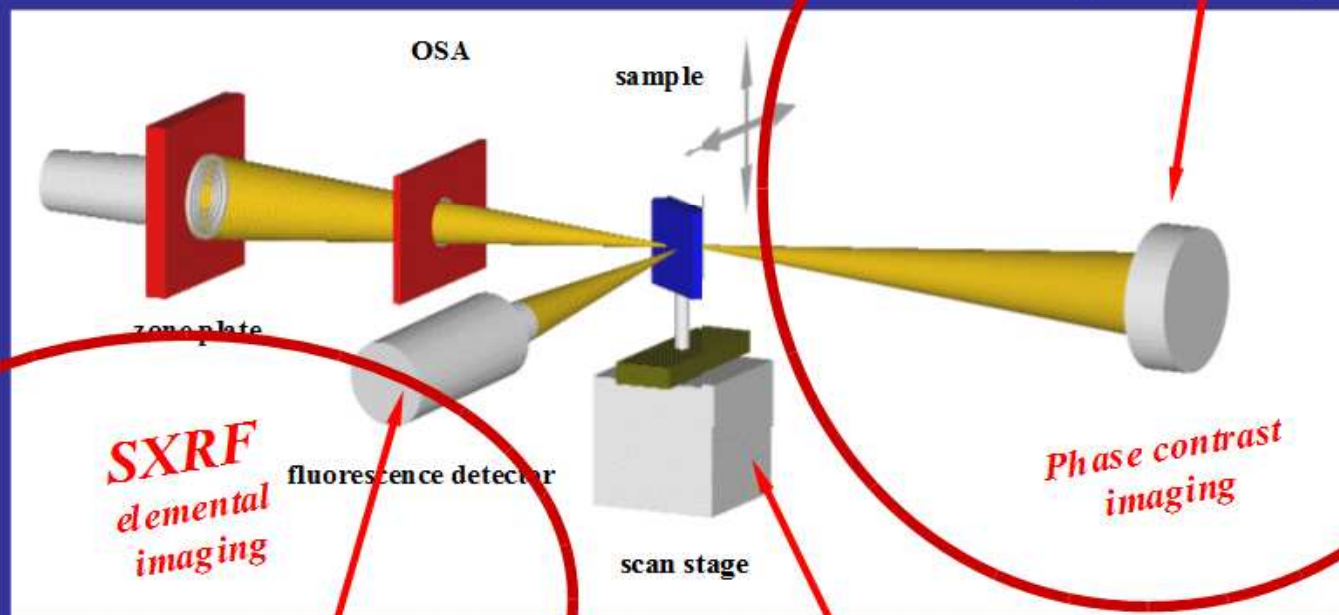- Potential collaborations with other facilities

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Scientific requirements

From NANOSCOPIUM beamline requirements :
"The aim is to do simultaneous ultrafast X-ray Fluorescence and Differential phase contrast/Coherent imaging
for obtaining
coupled elemental and structural information"

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Simultaneous measurement

Transmission detector:

APD or segmented diode or XPAD (or PILATUS)

OSA

sample

X-ray beam 5-20 keV

zone plate

SXRF
elemental
imaging

fluorescence detector

scan stage

Phase contrast
imaging

Single/4 element silicon-drift detector (e.g. Vortex+XIA)

Maia: planar silicon 384 detector array (CSIRO-BNL)

Stage: Precision XYZΘ

~5-10 nm resolution with laser-interferometry encoders and feedback

- 2D Detectors are only part of the acquisition systems on beamlines

  – *even if LIMA is part of the whole solution*

- Dealing with synchronisation of acquisitions is not the problem of software people

  – *I will not talk of the SPIETBOX project even if it is is part of the whole solution*

- The software architecture must be modular in terms of detectors

  – *It must be possible to add as many detectors of different kind to the whole system*

  – *The NANOSCOPIUM detectors is different from the SAMBA or DISCO beamlines*

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Software solutions

- Acquisitions systems are independent
  - ✓ *Only the electronic triggers couple them*
- Acquisitions must be done on the fly
  - ✓ *Acquisitions must are done on a continuous basis*
- It must be possible to add a new acquisition subsystem to the experiment
  - ✓ *Without having to change existing software*
- Acquisition systems are running on various hosts (or crates)

« Continous distributed acquisition systems or FlyScans»

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Interconnexion électrique pour scan continu Nanoscopium – Test Métrologie
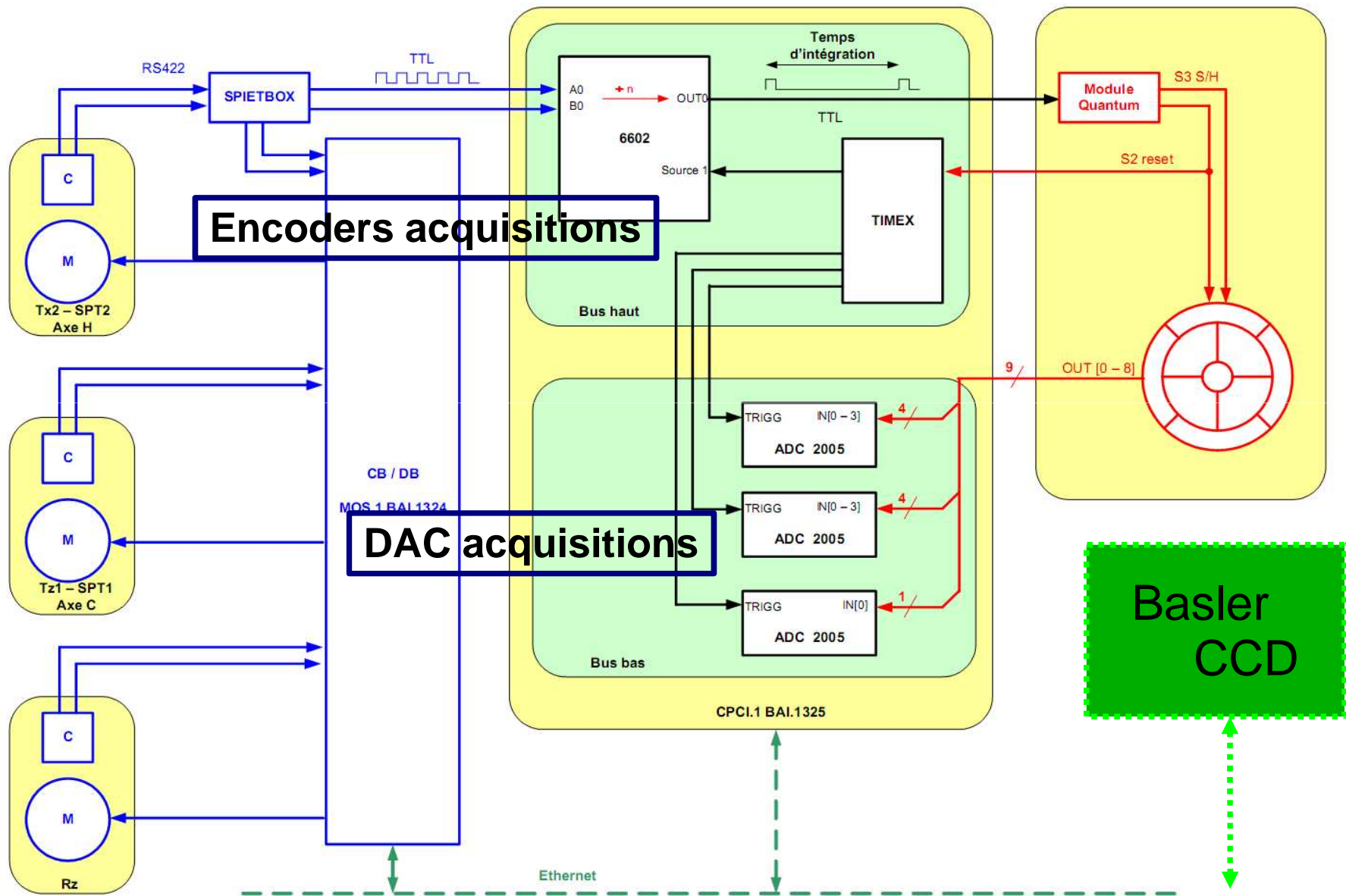
- Tango is distributed

    - So acquisition devices are distributed

- The beamline sequencer

    - Configure each acquisition subsystem (integration time, etc.)

    - « Arms » each subsystem to be « READY FOR ACQUISITIONS »

    - Start the data collection (motion, triggers generation,etc ..)

- Each device streams data on a continuous basis :

    - *on a temporary disk (so called the « spool »)*

    - *1 temporary file corresponds to an « acquisition frame » (may be different according to the experiment)*

- A generic process called the « data merger »

    - Checks the « spool » for temporary files

    - Merges temporary files into the final « experiment file »

    - Stores the final file on the mass storage system

    - Ask the DataRecorder device to add meta-data information

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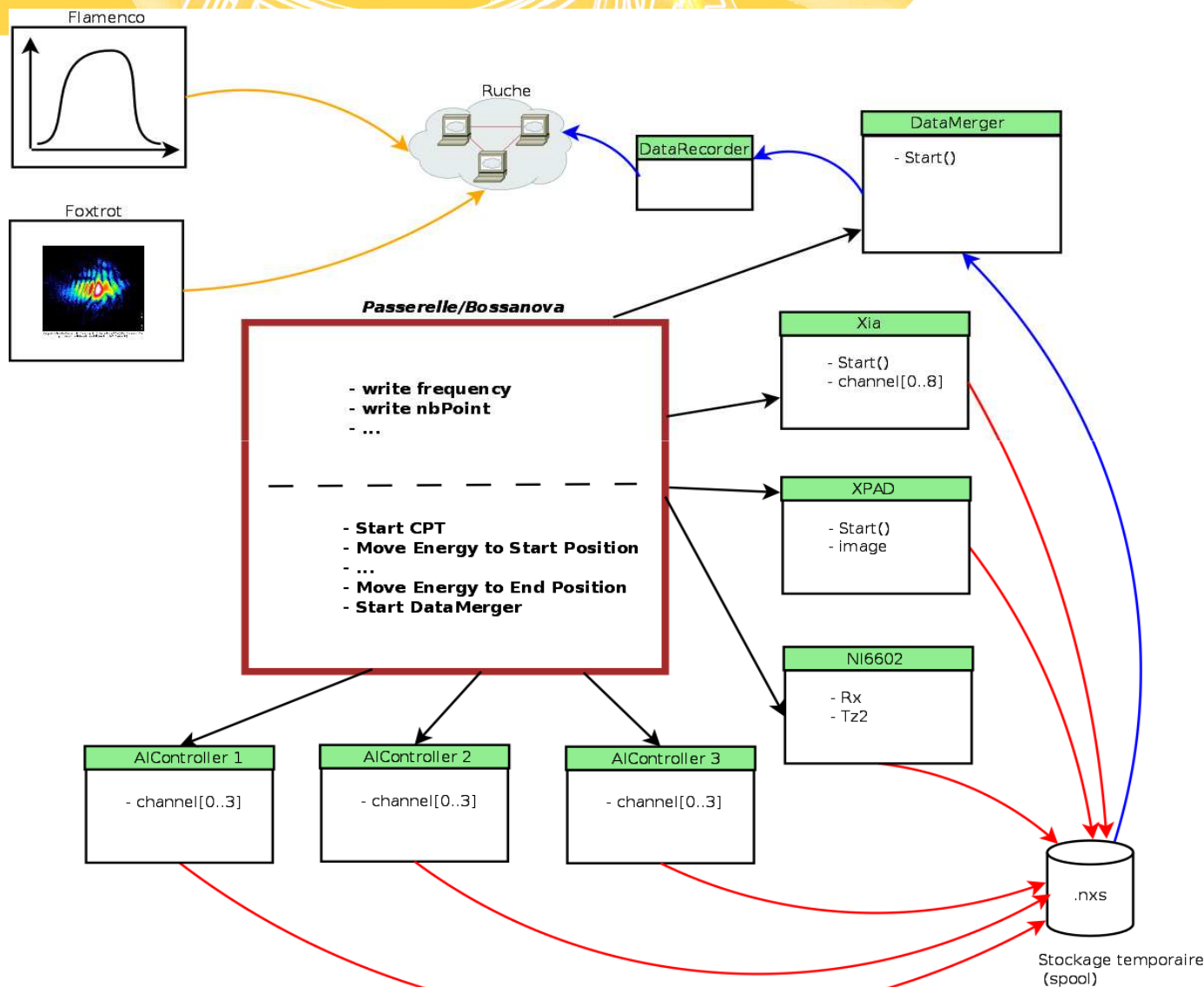
- A « «rock solid » file streaming library which :

  – *Does not slow down the acquisition taks in the device*

  – *Allows the final file reconstruction thanks to metadata tags put in the temporary files*

  – *We developped the so-called NeXus4Tango library for that purpose*

- NeXus4Tango is based on the NeXusAPI and adds extra mechanisms like:

  – *differed writings*

  – *« intelligent » data buffers handling*

  – *« Final file » reconstruction markers handling*

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- 2 beamlines are using such FlyScans on a daily operation basis :

SAMBA for so-called Quick EXAFS experiments

  - SAMBA is our champion beamline for data production on central mass storage system

  - DISCO (Quick SRCD)

  - In these cases no CCD is involved

- In March the Nanoscopium setup will be put in operation on the METROLOGIE beamline

  - With LIMA for CCD acquisitions

- We are today working in our Detectors lab on :

  - NeXus4Tango V2.0 (should be ready this week)

  - Its integration in the various acquisition devices

- Performances tests and tuning will start once software is stabilized

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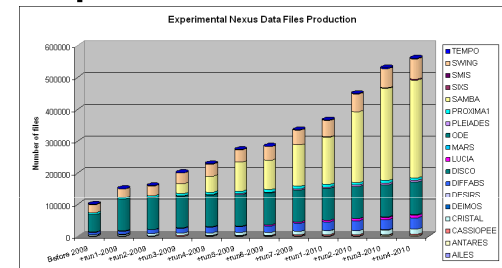
- ## At SOLEIL

  – *Performances tuning is still to be done*

  – *Deployment on other beamlines is forecast (PX1, SIXS, etc.)*

- ## Collaborating with other facilities would be great

  – *We are open to share and co-develop the* NeXus4Tango library

  – *The NeXus4Tango advanced file streaming mechanisms should be integrated in the* C++ *port of the* CommonDataModel

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