2D Detectors @ SOLEIL

& Integrated Acquisition for SOLEIL II

F. Langlois – NOBUGS 2024 – Lima satellite meeting

SOLEIL II
La science éclaire l'avenir
Science lights up the future

Agenda

- 2D detectors status
  - Deployement
  - Applications
- High Speed 2D detectors applications
  - Present
  - Futur
- Other developments

2D detectors status

SOLEIL II
La science éclaire l'avenir
Science lights up the future

2D detectors status

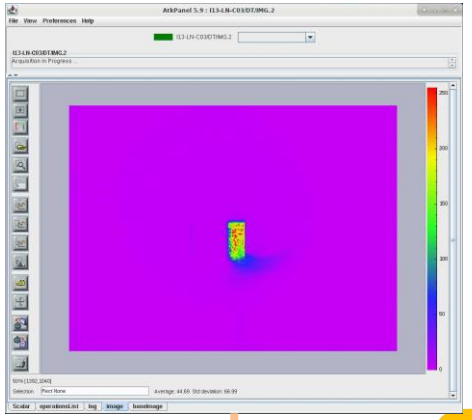
Lima for almost all 2D detectors

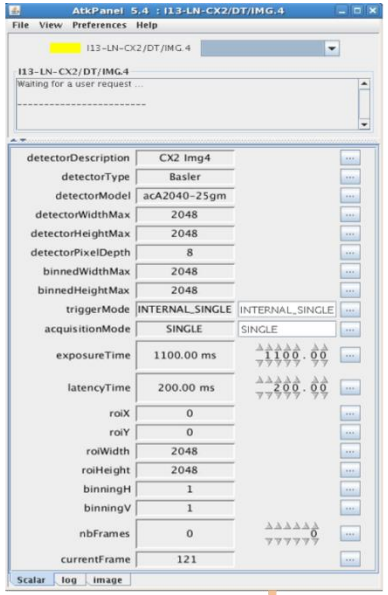
- Lima compatibility is required by the Detectors Group
- **23** detectors type, used in daily operation
- Deployed on **30** Control Systems including accelerators and beamlines
- Basler:
  - Linux only
  - ~ **200** instances
  - Pylon 5
  - Some ACE2 PRO with Pylon 6
- Dhyana
  - Windows
  - 8 instances
- Eiger
  - 3
- EigerPSI / JungFrau
  - 2
  - Custom SOLEIL plugin (not the ‘slsdetector’)
- Hamamatsu
  - Windows
  - 15 instances
- ImXpad
  - 8
- Lambda
  - 3
- Merlin
  - 10
- PCO
  - Windows
  - DIMAX, 4000, Edge, PixelFly
  - 9
- Pilatus
  - 4
- UFXC
  - 2
  - Transverse on 9 BL

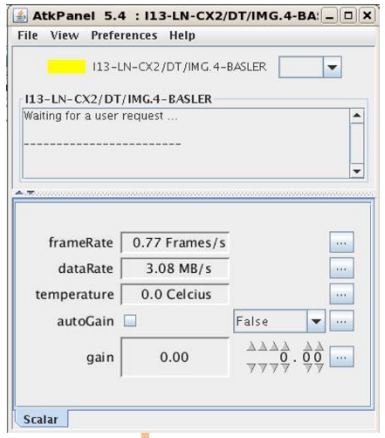
Made by SOLEIL:
- Lima integration from start
- Extremely stable

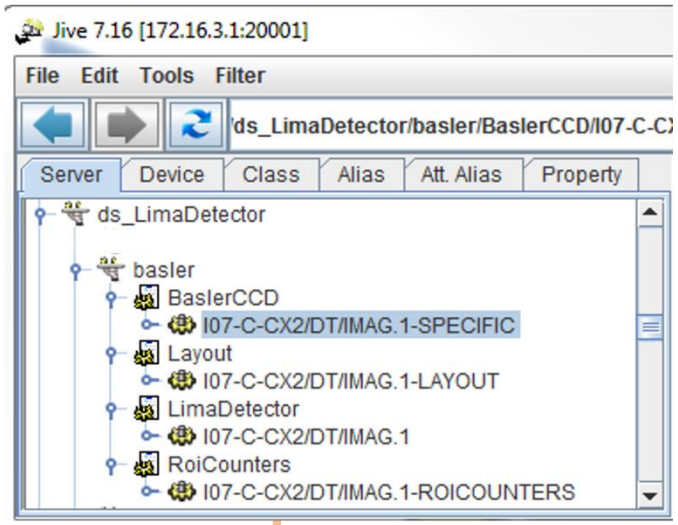
Tango Device

- C++
- Classes:
  - Generic: **LimaDetector**
  - Specific: eg **Basler**
  - Optional: Layout, RoiCounters, Mask
- https://lima-tango-cpp.readthedocs.io/en/master/









TANGO Software bus

ds_LimaDetector

Optional

LimaDetector	BaslerCCD	Layout	RoiCounters
▪ Start ▪ ExpoTime ▪ NbFrames ▪ …	▪ IPAddress ▪ PacketSize ▪ Gain ▪ …	▪ Flip ▪ Rotate ▪ …	▪ Rois ▪ Sum ▪ Std ▪ …

Lima (LimaCore + LimaBasler + Processlib)

Application

- Beam Monitor
  - Lima Basler
  - **ImgBeamAnalyzer** Tango device
    - OpenCV based
    - Lot of operations on beam image: profiles, moments, 2D fitting …
    - Eg: Used in alignement scans
  - GUI

Charleston 3.5.22-51 - 2023-07-28 11:40:38

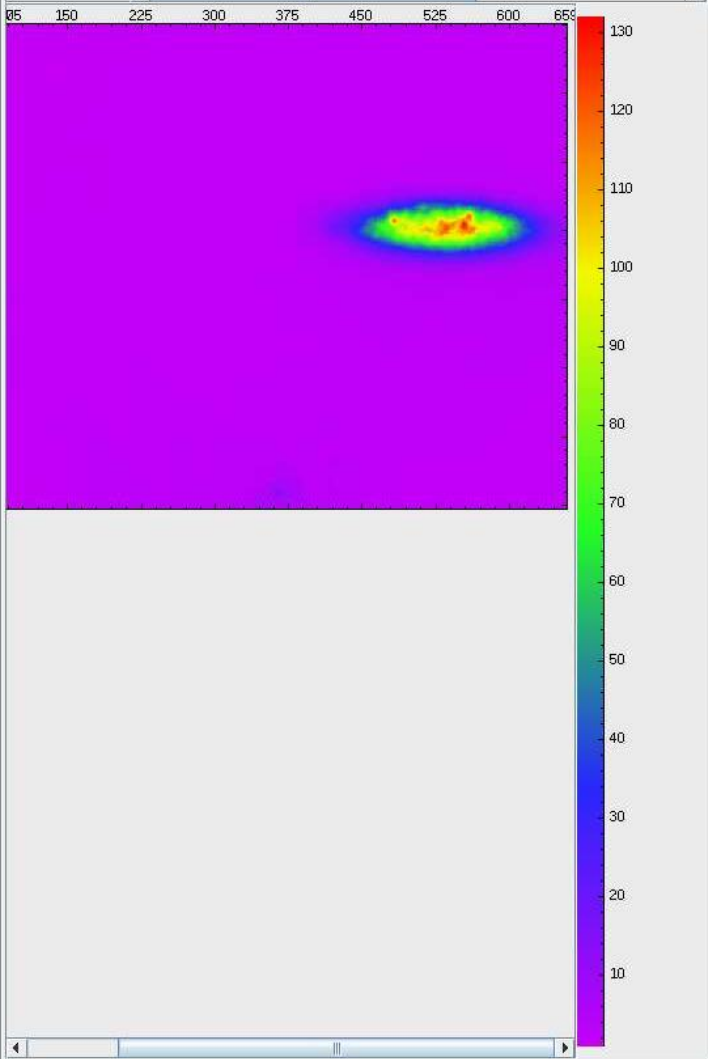
File Edit Help Layout

General

Image Management | Image 2D Fitting | Histogram

Analyzer Input Image

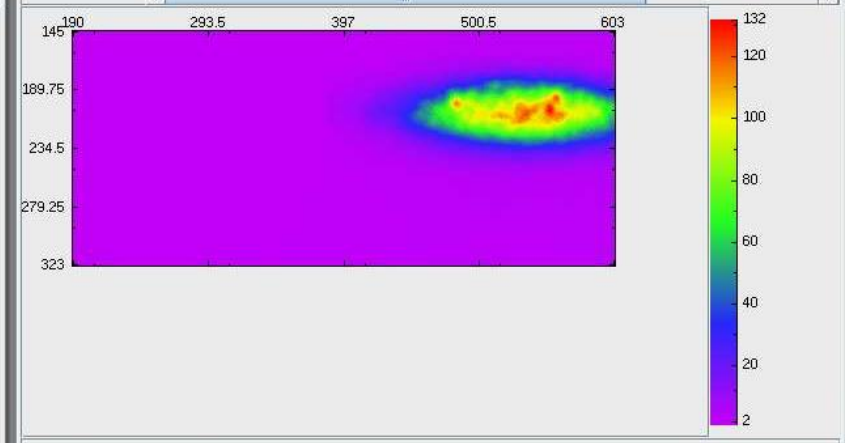
Use profiles



Zoom: 75% axes: [out] Show Statistics

Analyzer ROI Image Viewer

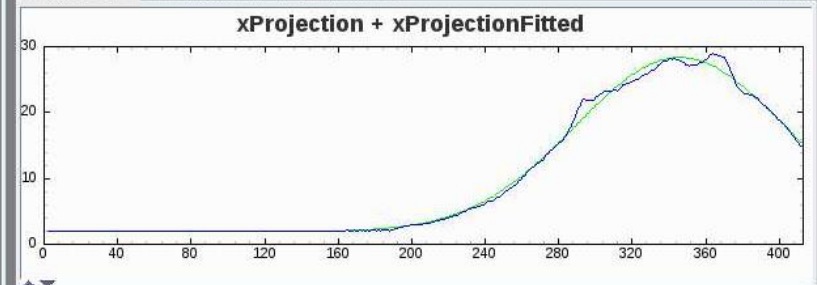
Use profiles



Zoom: 3200% axes: [out] Show Statistics

Analyzer ROI Image Profile

X Projection | Y Projection | Line Profile for Fit



Freeze Values | Clear Freezes

Visible data views: | Hide

Hidden data views: | Display

xProjection | xProjection + xProjectionFitted | xProjectionError

Image Grabber

Scalar Attributes

exposureTime	1.00 ms

Analyzer Moments

enable image moments	true
max intensity	132
mean intensity	9.96
centroid X	498.39 um
centroid Y	214.23 um
variance X	7194.54 um^2
variance Y	962.73 um^2
covariance XY	-542.99 um^2
correlation XY	-0.2063
skew X	-987202.14 um^3
skew Y	37435.67 um^3
skew X2Y	92179.81 um^3
skew XY2	-56430.78 um^3

Analyzer Pre-Processing

rotation	0 deg
horizontal flip	false

Analyzer User ROI

Analyzer Auto ROI

enable user ROI	true	
origin X	190 pix	Write
origin Y	145 pix	Write
width	414 pix	Write
height	179 pix	Write
SaveCurrentSettings		Write All

Analyzer Line Profile

origin X	0 pix	Write
origin Y	0 pix	Write
end X	0 pix	Write
end Y	0 pix	Write
thickness	1 pix	

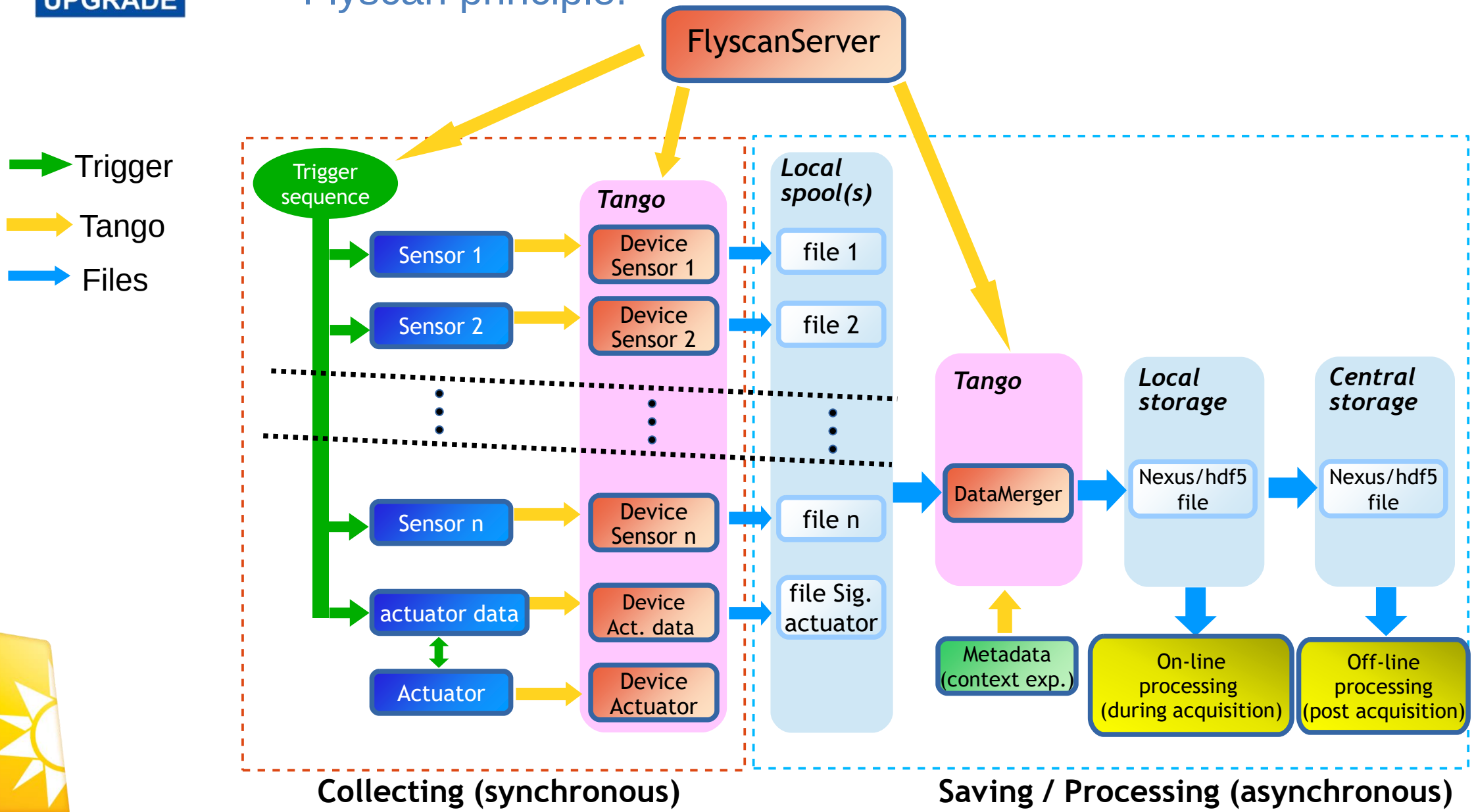
i13-ln-c05/dt/img-analyzer The device is up and running

I13-LN-C05/DT/IMG Acquisition in Progress ...

High Speed 2D detectors applications

SOLEIL II
La science éclaire l'avenir
Science lights up the future

- Almost all High Speed applications work with our **Flyscan** system
- Flyscan principle:

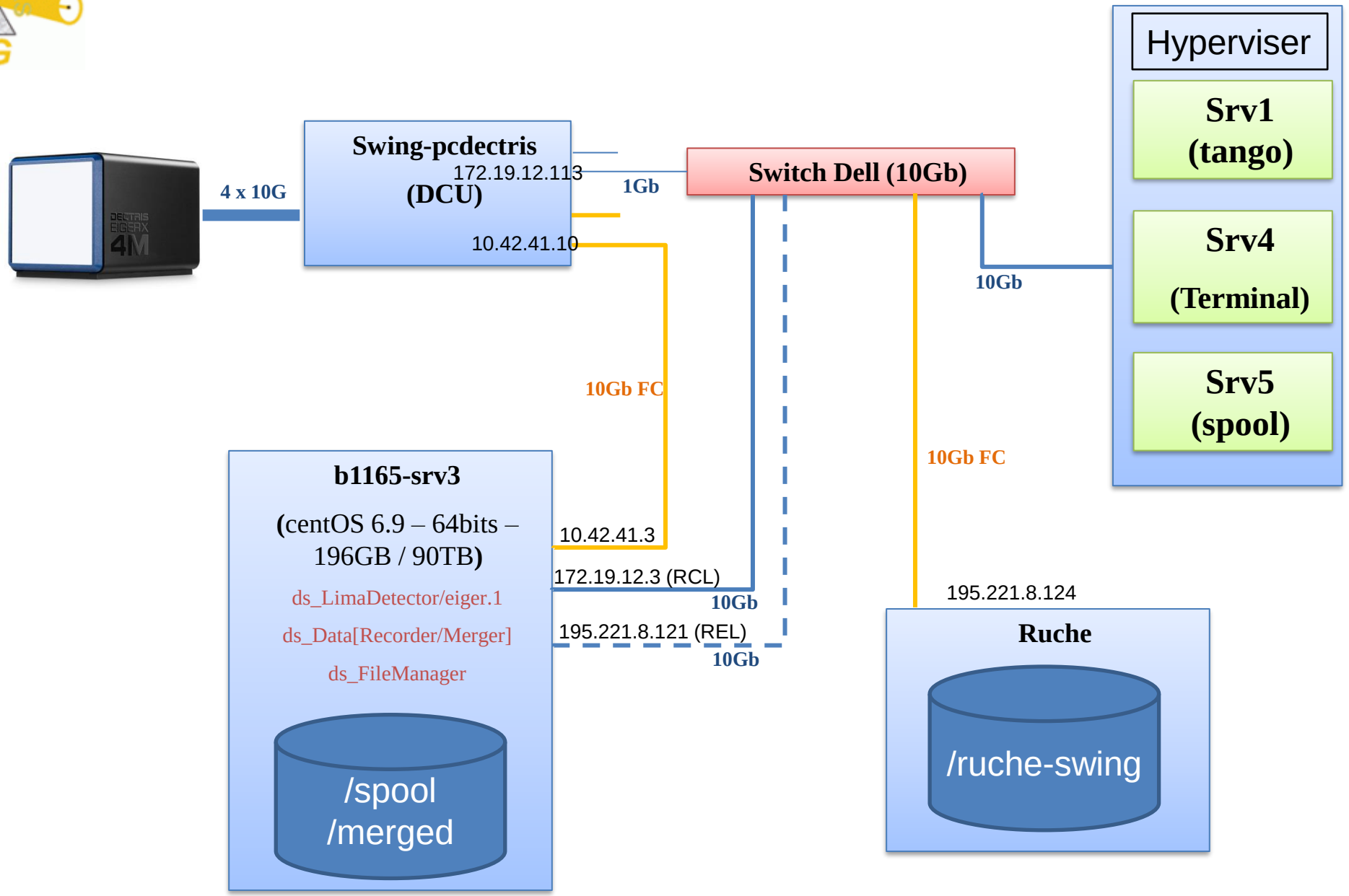


Present applications

Main SOLEIL's Flyscan applications

- Eiger 4M (Swing)
  - SAXS/WAXS
  - 160 MB/s
- Hamamatsu / PCOs (Psiché/Anatomix)
  - Full field tomography
  - ~ 800 MB/s
- UFXC
  - Phase Contrast, Time Resolved
  - 200 MB/s
- EigerPSI (Nanoscopium)
  - Coherent Diffraction Imaging
  - 350 MB/s
- CIRPAD (Diffabs)
  - XRD
  - 350 MB/s
- Lambda 2M (Cristal)
  - XRD
  - 100 MB/s

Eiger 4M Swing

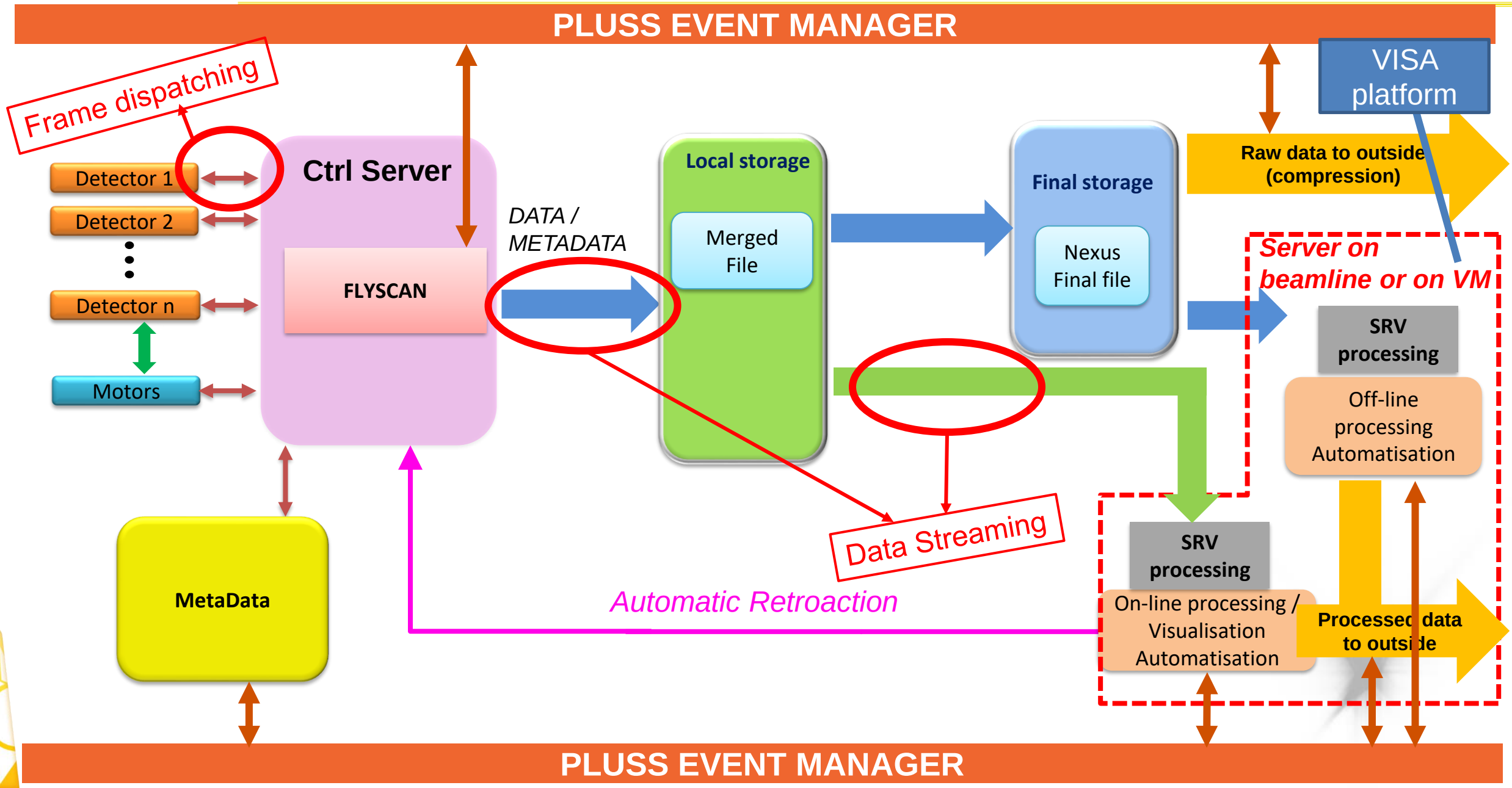


Limitations

- Only 1 network link between the detector and the Lima client
  - Currently only 10Gb
- SOLEIL II: Will need to support higher frame rates
  - dispatching the frame
- Not yet full online analysis (only small data reduction)

Integrated Acquisition

SOLEIL II's Integrated Acquisition



Integrated Acquisition

- Lima2 study
  - Still in progress
- Data Streaming study :
  - ASAPO (DESY)
    - Broker based
    - GPFS
  - Blissdata (ESRF)

ASAP::

Blissdata

Other developments

SOLEIL II
La science éclaire l'avenir
Science lights up the future

- Tango **PyImgProcessor**
  - Developed by Ctrl-Acq group (A. Noureddine)
  - Image Processing
  - Generic (Tango interface + processing)
  - Yaml config + plugins
    - Classics (threshold, contours, centroid, blur, …)
    - Deep Neural Network : load AI Model for sample alignment
  - A replacement candidate for ImgBeamAnalyzer (and other Img processing devices)
  - In production on 2 BL
- Tango **MicroManager**
  - Developped by Det group (K. Desjardins)
  - Interface quickly all MM camera
  - Used mainly to do commissionning
  - Windows only
  - Integration into Lima?

- Thanks for your attention
- Questions ?
- Thanks to SOLEIL people:
  - A. Noureddine, S. Poirier, A. Dawiec, K. Medjoubi

Backup

Architecture FLYSCAN – Nanoscopium XRD

RCL

REL

EigerPSI (16 bits,
524 288 pixels, 300 KHz)

srv-eiger1

LimaDetector /EigerPSI

2 x 10 Gb

A

Srv3

FlyscanServer

RecordingManager

Data

Metadata

local storage (spool)

Temp Nexus files

Final Nexus file

FileTransfer

DataMerger

FlyscanViewer:
On-line processing / Visualisation

B

Ruche Local Cell

Final Storage (Ruche Users)

Final Nexus file

D

Ruche Centrale

C

Srv Processing

Matlab (Off-line processing)

A:
Lien 10 Gb
- Switch 10 Gb
- Vlan

Mesure débit srv-eiger → spool :
- FTP : **540 – 590 MB/sec** (nouvelles mesures: **950 MB/sec**)
- CP via NFS : **525 MB/sec**

B:
Lien 10 Gb direct
Mesure débit spool → ruche :
- CP via NFS : **360 MB/sec** (nouvelles mesures: **450 MB/sec**)

C:
Lien 10 Gb
Mesure débit ruche → srv proc. :
- CP via NFS : **407 MB/sec**

Si B et C en même temps:
B: **296 MB/sec**
C: **265 MB/sec**

```yaml
---
actions:
 ################################################################
   # Action to acquire the image
  - name: snap
    plugin: snap_plugin
    inputs:
      # Tango url of attribute image
      source: "i06-c-c00/dt/basler.4/image"
      # Tango Command to acquire image
      cmd_acq: "Snap"
      # Tango State during acquisition image
      state_acq: "RUNNING"
      # Tango State after acquisition image
      state_idle: "STANDBY"
    outputs:
      # image output
      image: snap_image
      # Enable/Disable saving the output image
      save : True
    attributes :
      # Tango Attributes
      path: snapPath
      image: snapImage
 ################################################################
   # Action to load the bgrnd image
  - name: load
    plugin: load_plugin
    inputs:
      # Path to the bgrnd file image
      source: "/home/experiences/cristal/com-cristal/ICA/arafat/PyImgProcessor/data/bgrnd_image.png"
    outputs:
      # image output
      image: bgrnd_image
      # Enable/Disable saving the output image
      save: True
    attributes :
      # Tango Attributes
      path: bgrndPath
      image : bgrndImage
 ################################################################
```