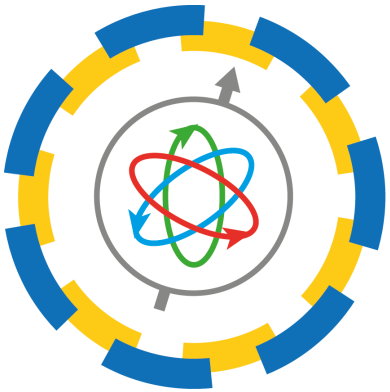
Overview of the software architecture for the J-PET tomography device



J-PET

Wojciech Krzemień

II Symposium on Positron Emission Tomography

23th of September 2014, Kraków

INNOWACYJNA GOSPODARKA
NARODOWA STRATEGIA SPÓJNOŚCI

UNIWERSYTET JAGIELLOŃSKI W KRAKOWIE

FNP
Fundacja na rzecz Nauki Polskiej

UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ ROZWOJU REGIONALNEGO

J-PET software

Development of the software that covers
the full data flow
(from hardware to viewer)

- PET image reconstruction and visualization are highly time- and resource-consuming processes
- Additional flexibility required at the development stage (different algorithms, different approaches tested in parallel)

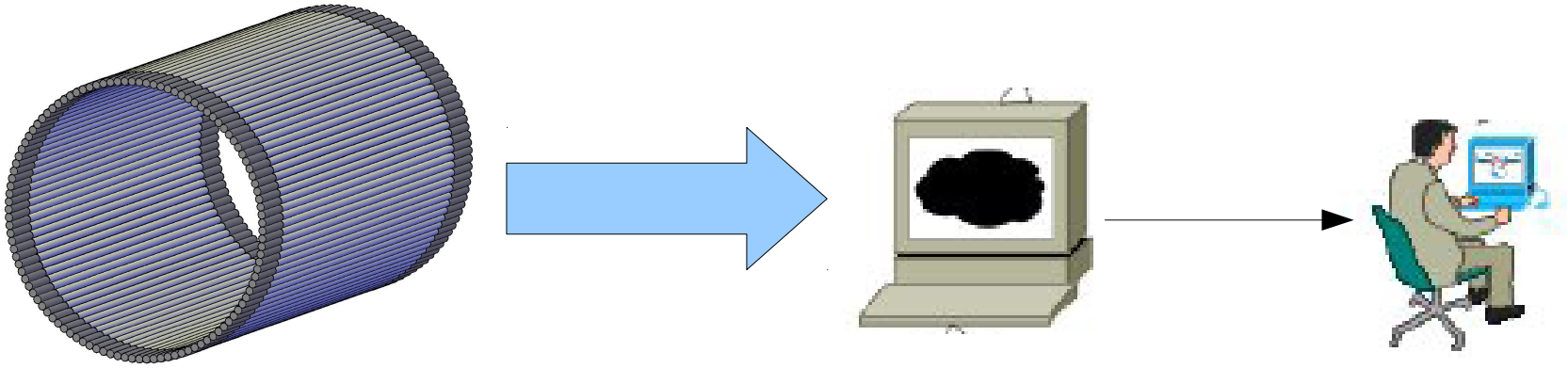
J-PET software

Development of the software that covers
the full data flow
(from hardware to viewer)

We need:

- data storage, dedicated computing resources
- high-bandwidth transfer links
- efficient algorithms (parallelization)
- other issues e.g. data security

Computing and data flow I

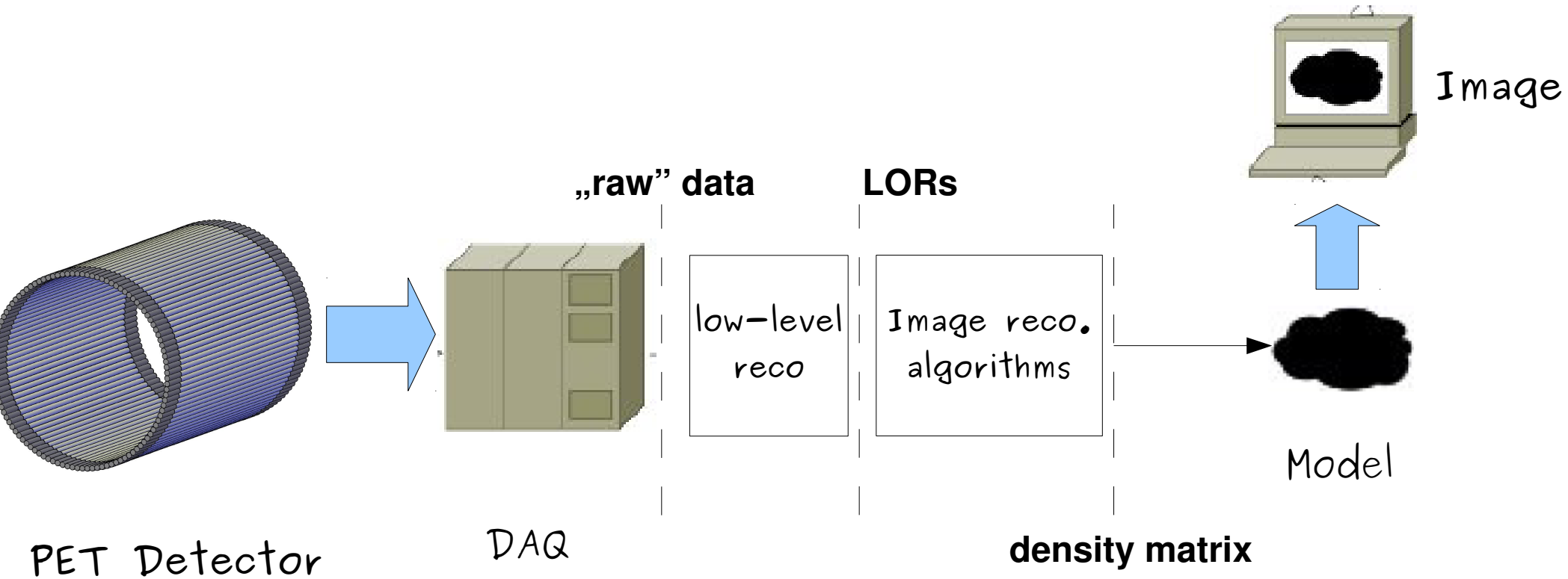


PET Detector

Image

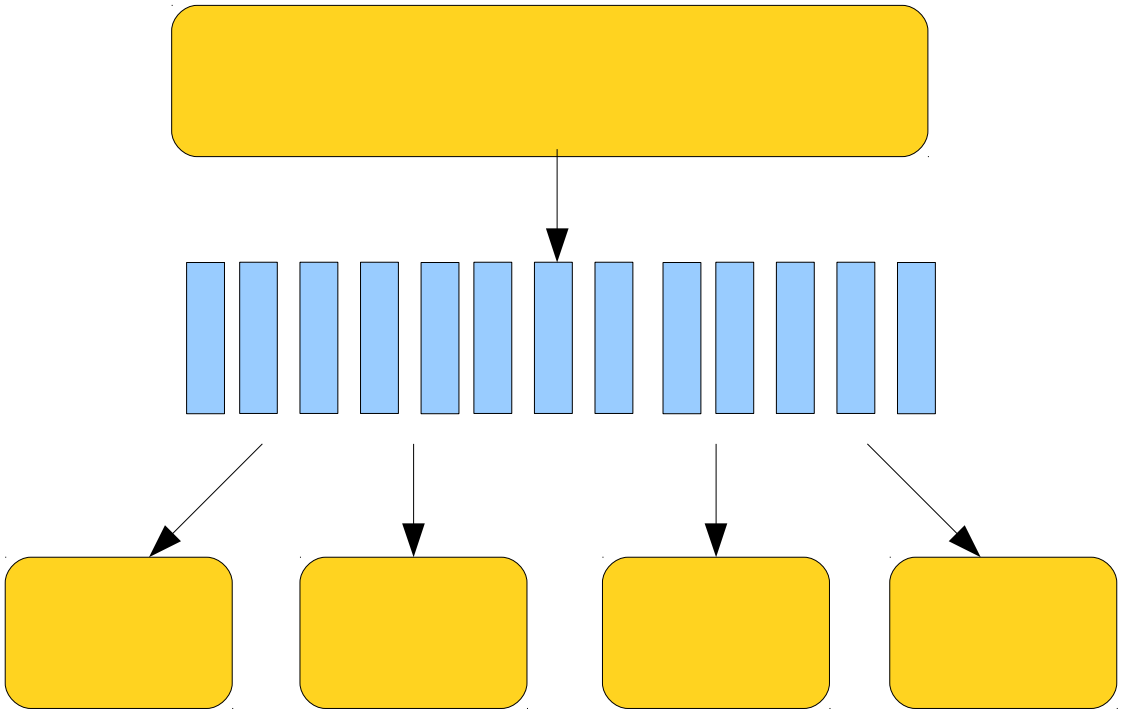
Physician

Computing and data flow II

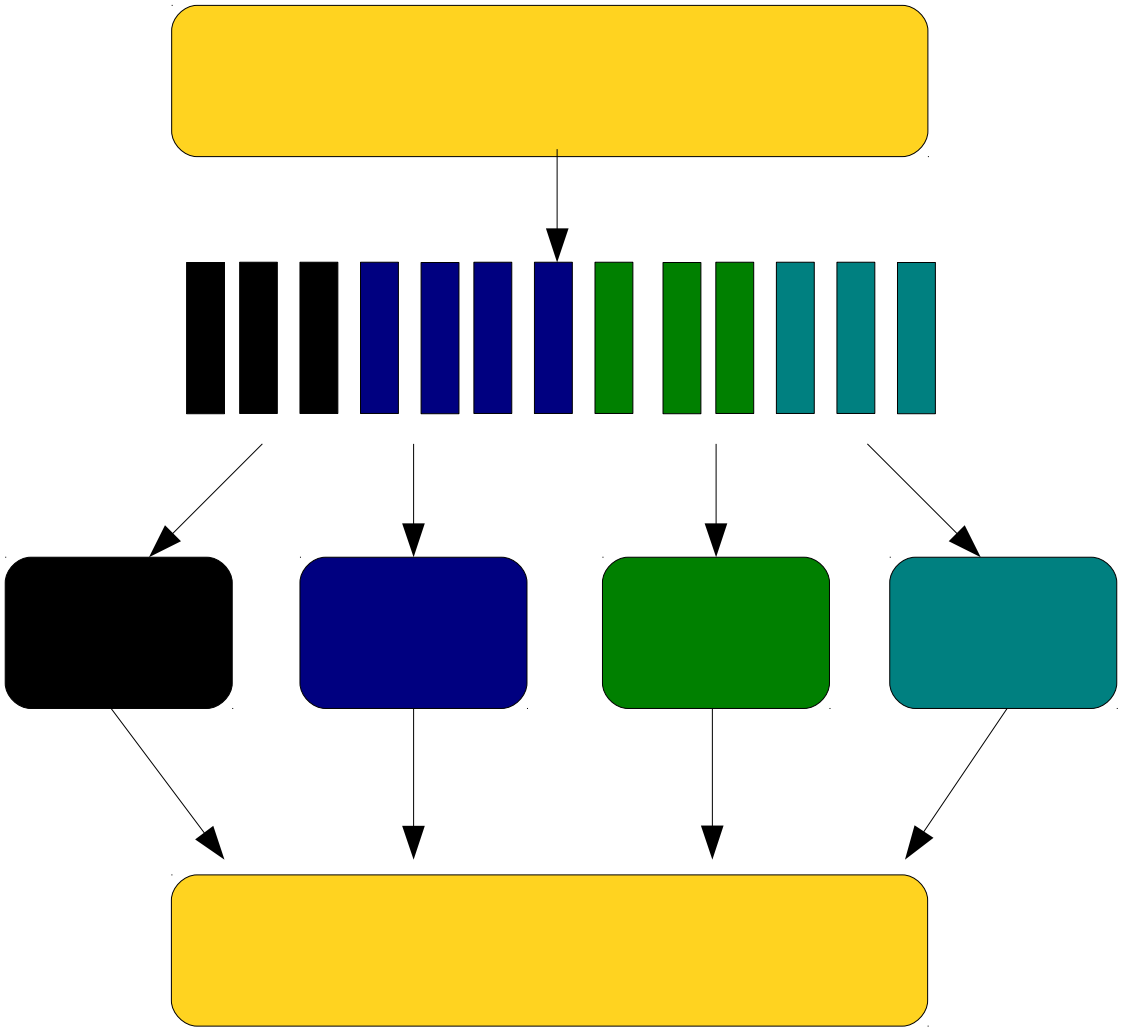


- LOR = Line-of-response
- Low level reconstruction e.g. hit position reconstruction, line-of-response reconstruction, but also some calibration procedures

Parallelization

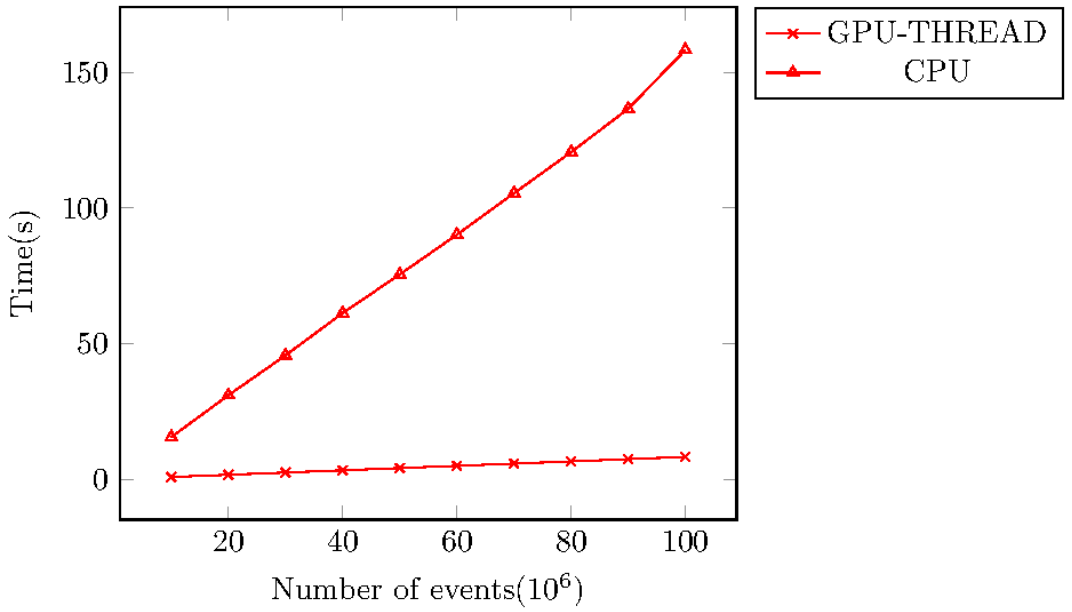


Parallelization



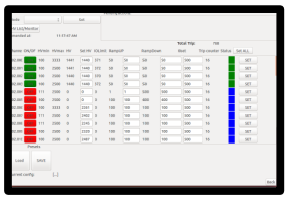
Parallelization

- CPU (Central Processing Unit)
- GPU (Graphics Processing Unit)
- FPGA(Field Programmable Gate Array)



Comparison between CPU and GPU reconstruction time per iteration for example Shepp-Logan phantom

Pet controller - steering and monitoring



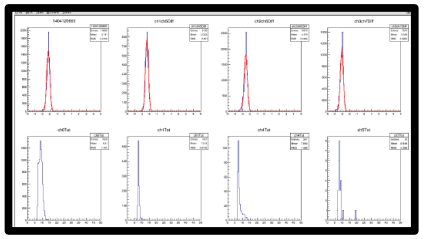
HV control

storage

J-PET prototype

DAQ

PET controller
(server)

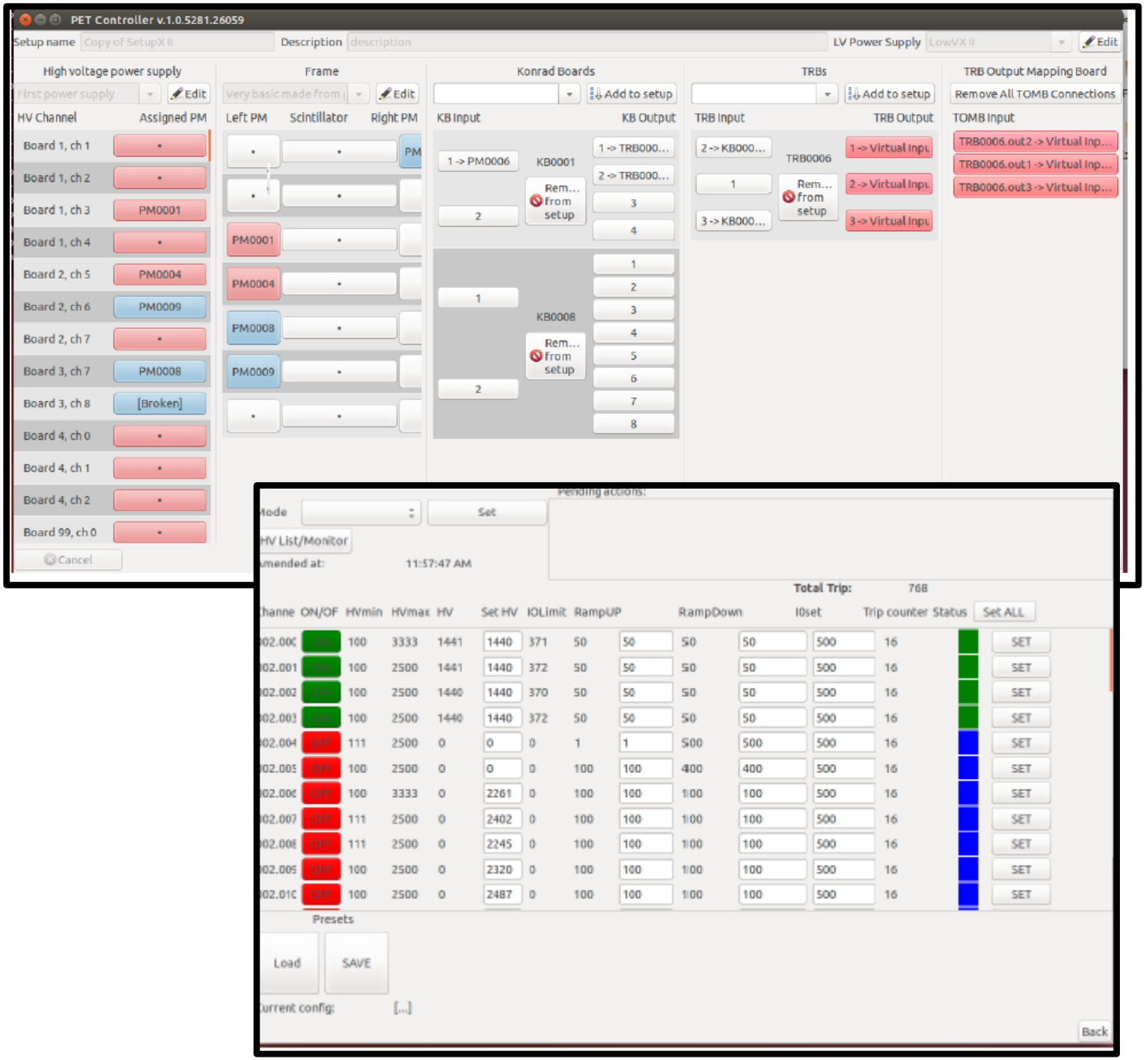


Online monitoring

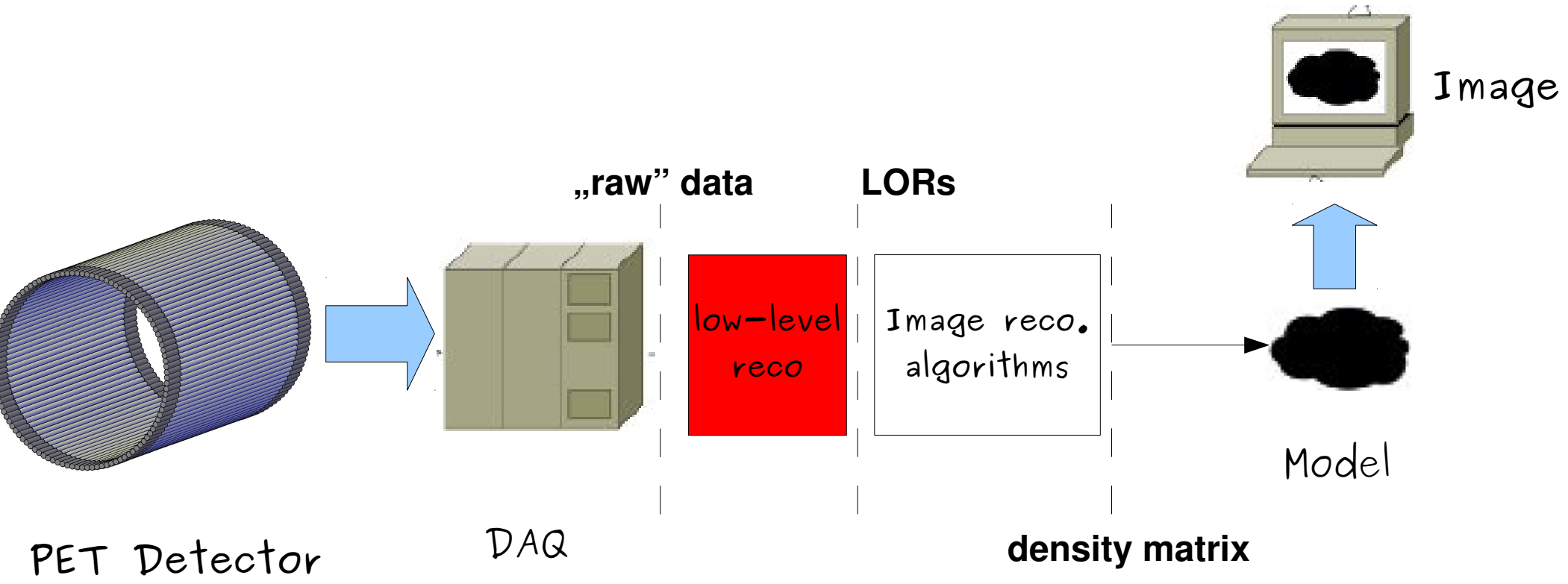
Parameter database

In coordination with Silvermedia company

PetController - Interface example



Computing and data flow II

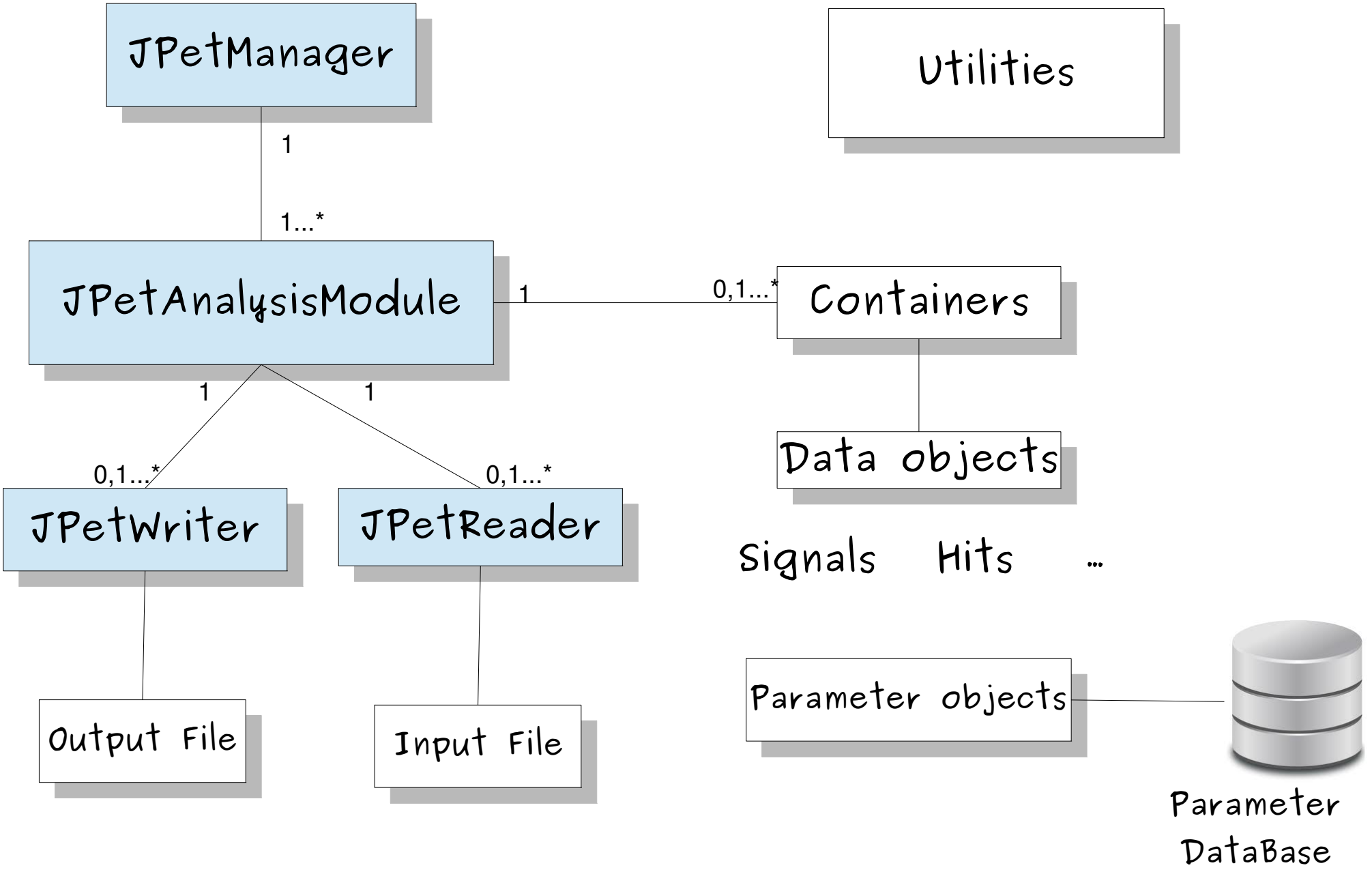


Reconstruction framework

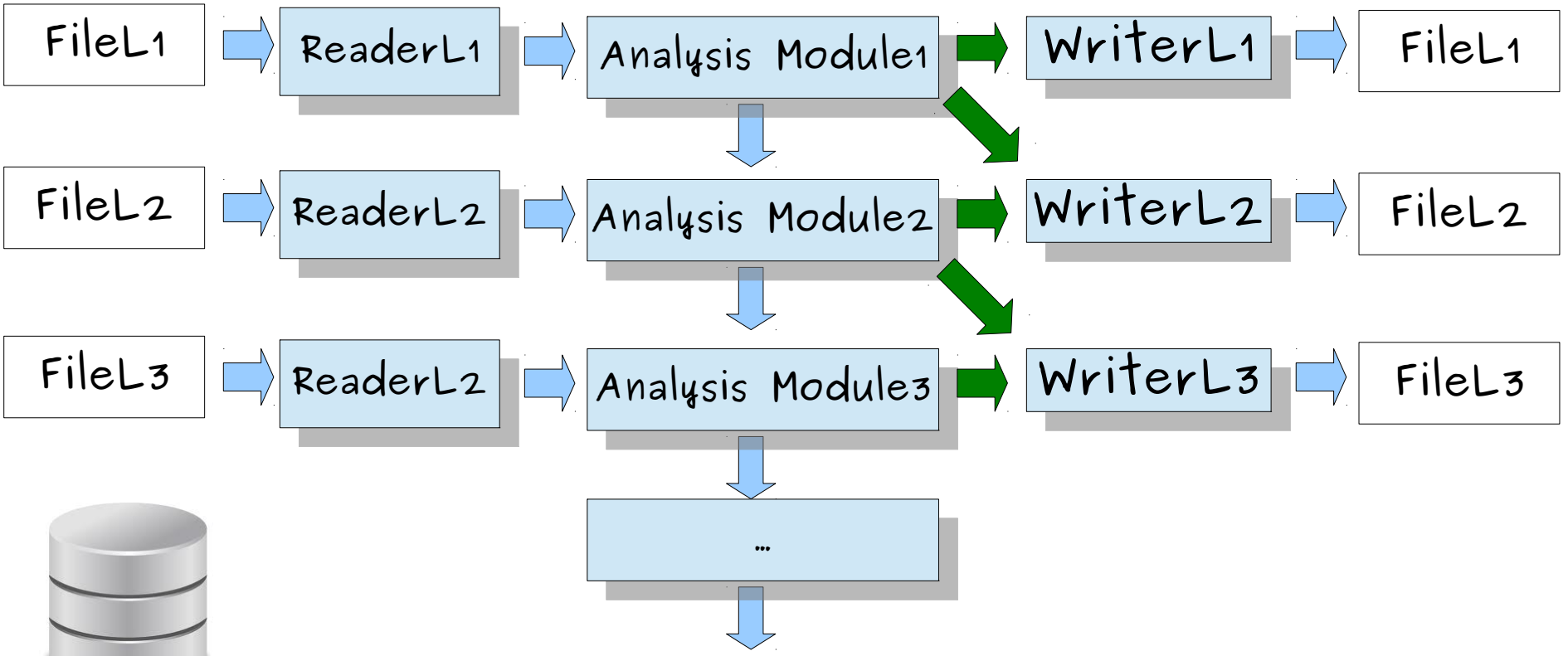
- Software environment for implementation of low-level reconstruction and calibration procedures
- Objectives:
  - Provide a set of software tools,
  - Define common methods and techniques for I/O operations,
  - Handle (hide) the communication with databases
- Technologies & tools: C++, BOOST,git, Doxygen, ROOT

W. Krzemień et al. Bio-Algorithms and Med-Systems. Volume 10, Issue 1, Pages 33-36 (2014)

General architecture



Data flow



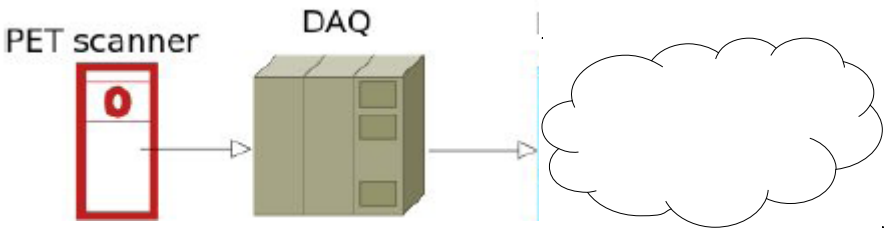
Parameter DataBase

Analysis Module e.g.:

- Matching procedure
- Reconstruction procedure
- Calibration procedure

General computing architecture

- In-place processing:
  - CPUs
  - GPUs
  - FPGAs
- Distant processing:
  - Cloud
  - Grid

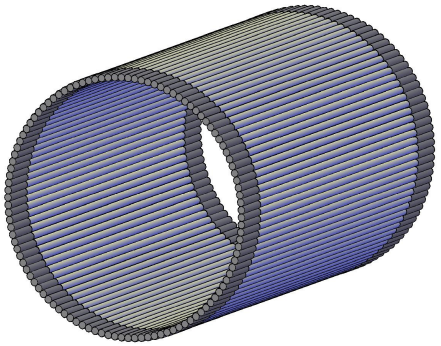


- Data security issues (medical data)

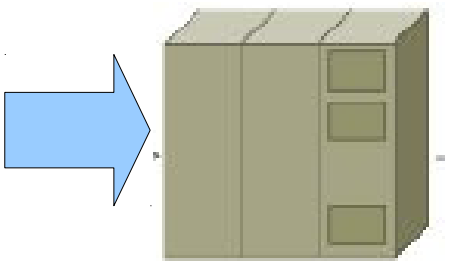
Outlook

- The overall software architecture that covers the whole data flow is being developed by the J-Pet collaboration
- Parallelization techniques are applied to reduce the computing time
- Several computing models are considered to use

Next talks



J-PET Detector



DAQ

„raw" data

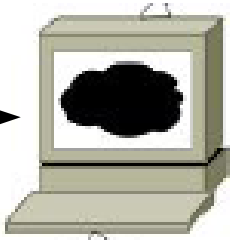
low-level reco

LORs

Image reco. algorithms

density matrix

Image



Talks of:
P. Moskal
S. Niedzwiecki
A. Wieczorek &
Ł. Kapłon

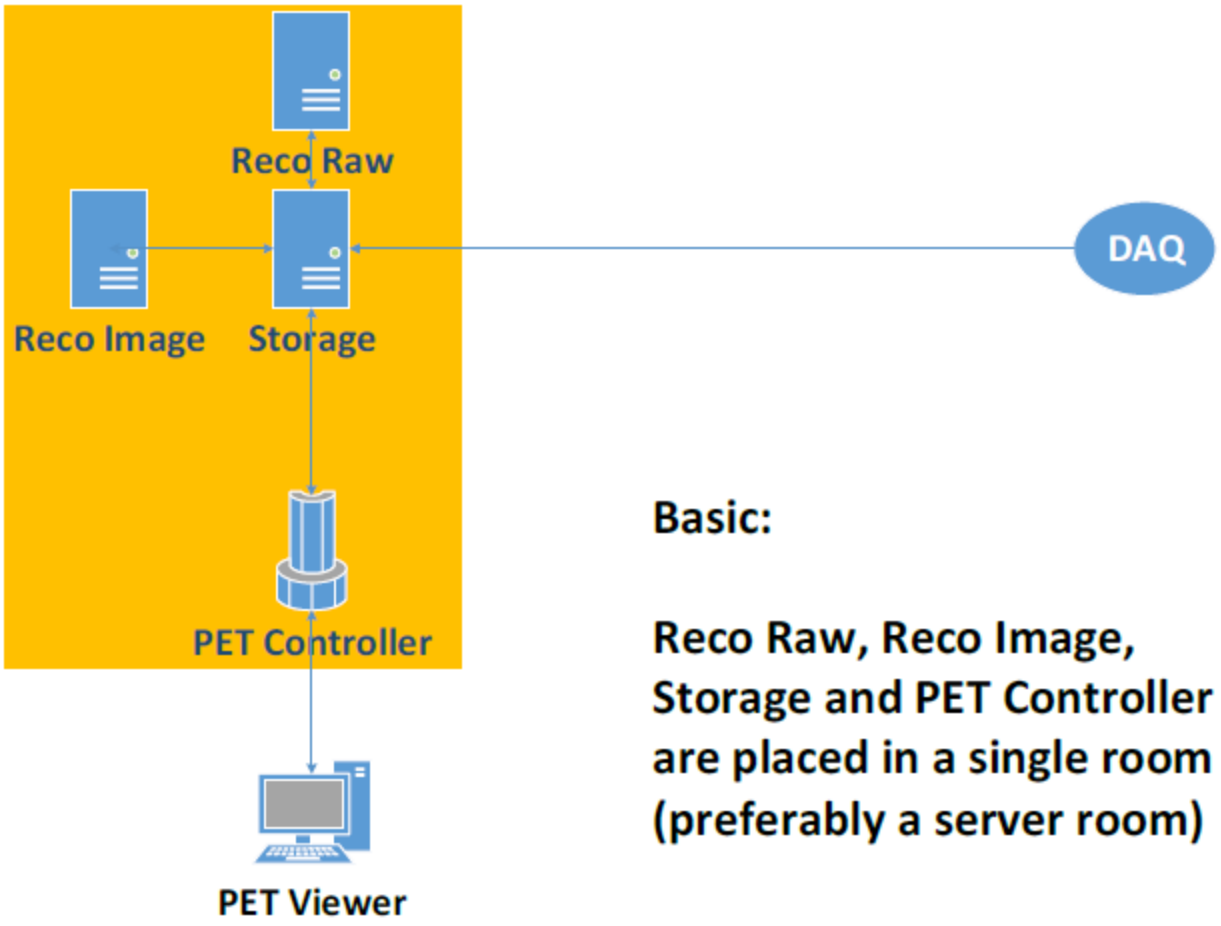
Talks of:
P. Strzempek
G. Korcyl

Talks of:
L. Raczyński
N. Zoń &
N. Sharma
T. Bednarski

Talks of:
P. Białas
A. Strzelecki
& J. Kowal

P. Kowalski – MC simulations in GATE

Computing architecture I

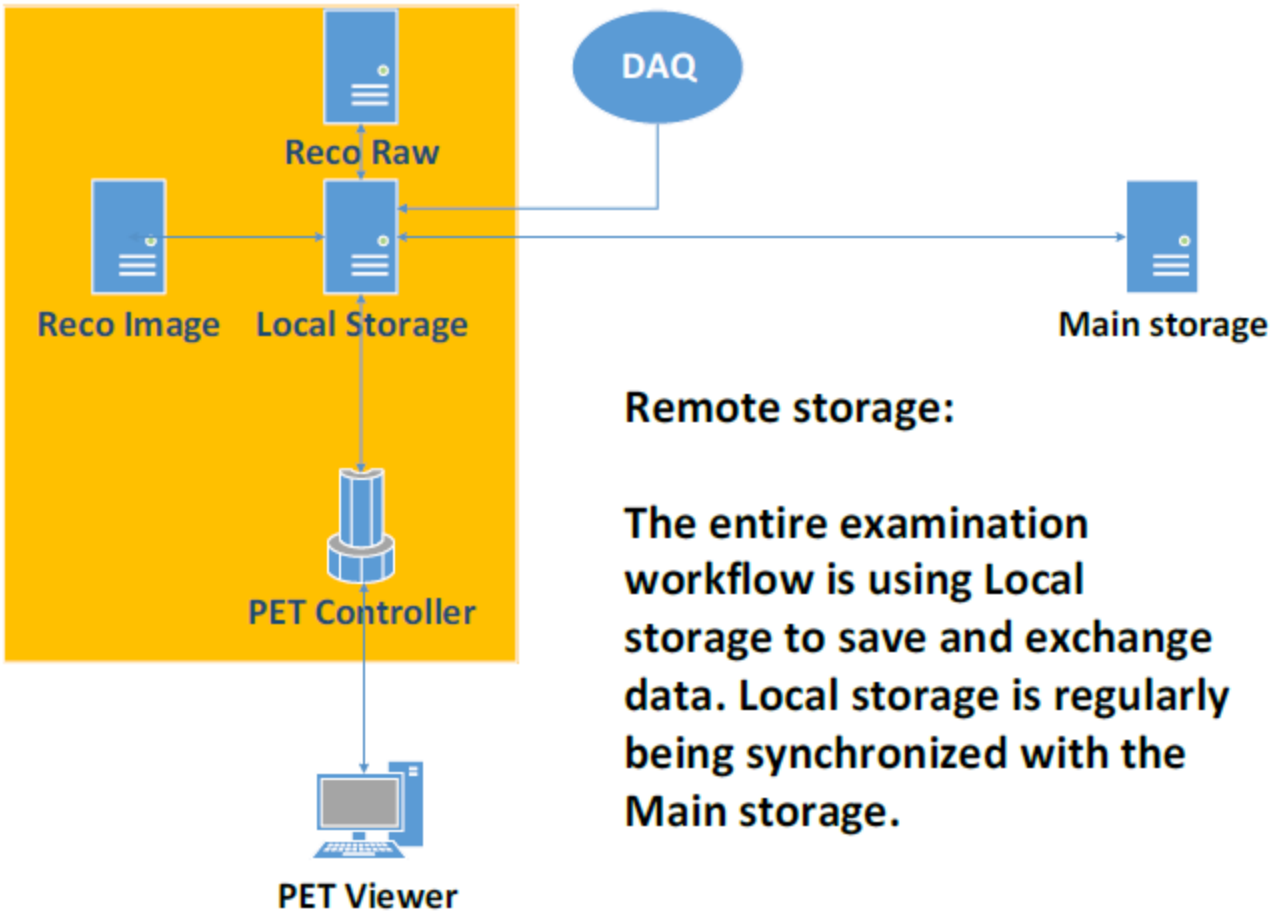


Basic:

Reco Raw, Reco Image, Storage and PET Controller are placed in a single room (preferably a server room)

Cooperation with Silvermedia

Computing architecture II

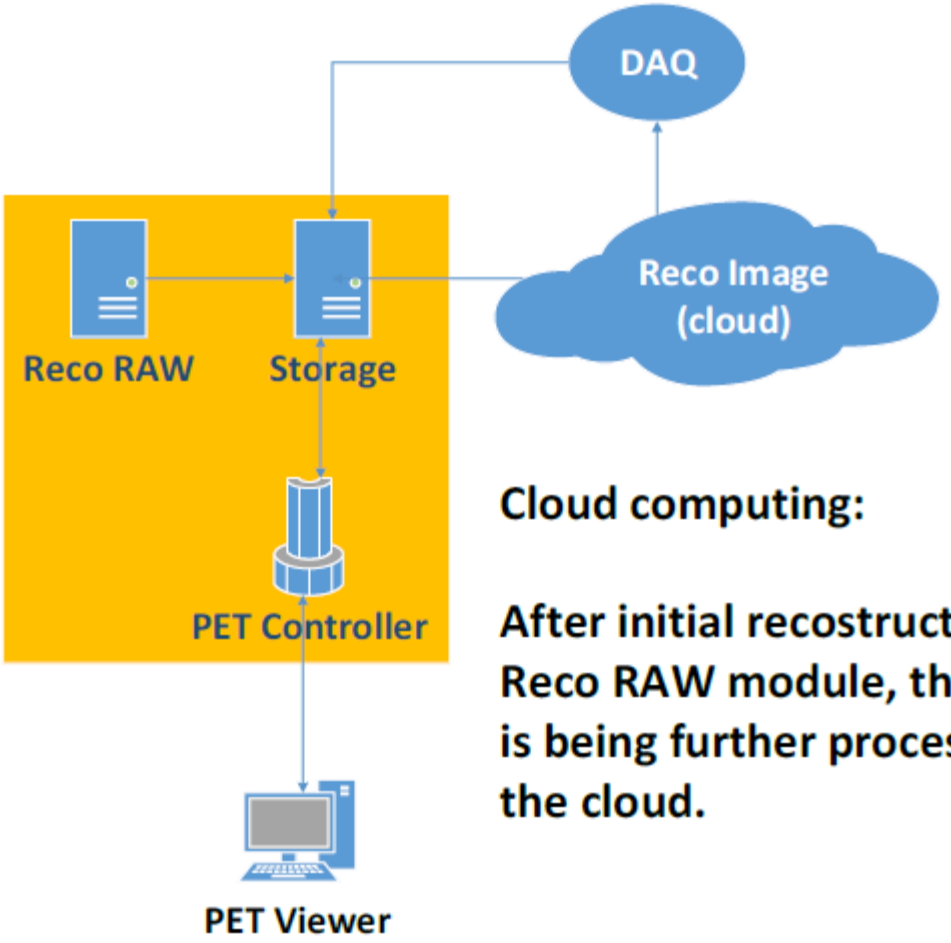


Remote storage:

The entire examination workflow is using Local storage to save and exchange data. Local storage is regularly being synchronized with the Main storage.

Cooperation with Silvermedia

Computing architecture III

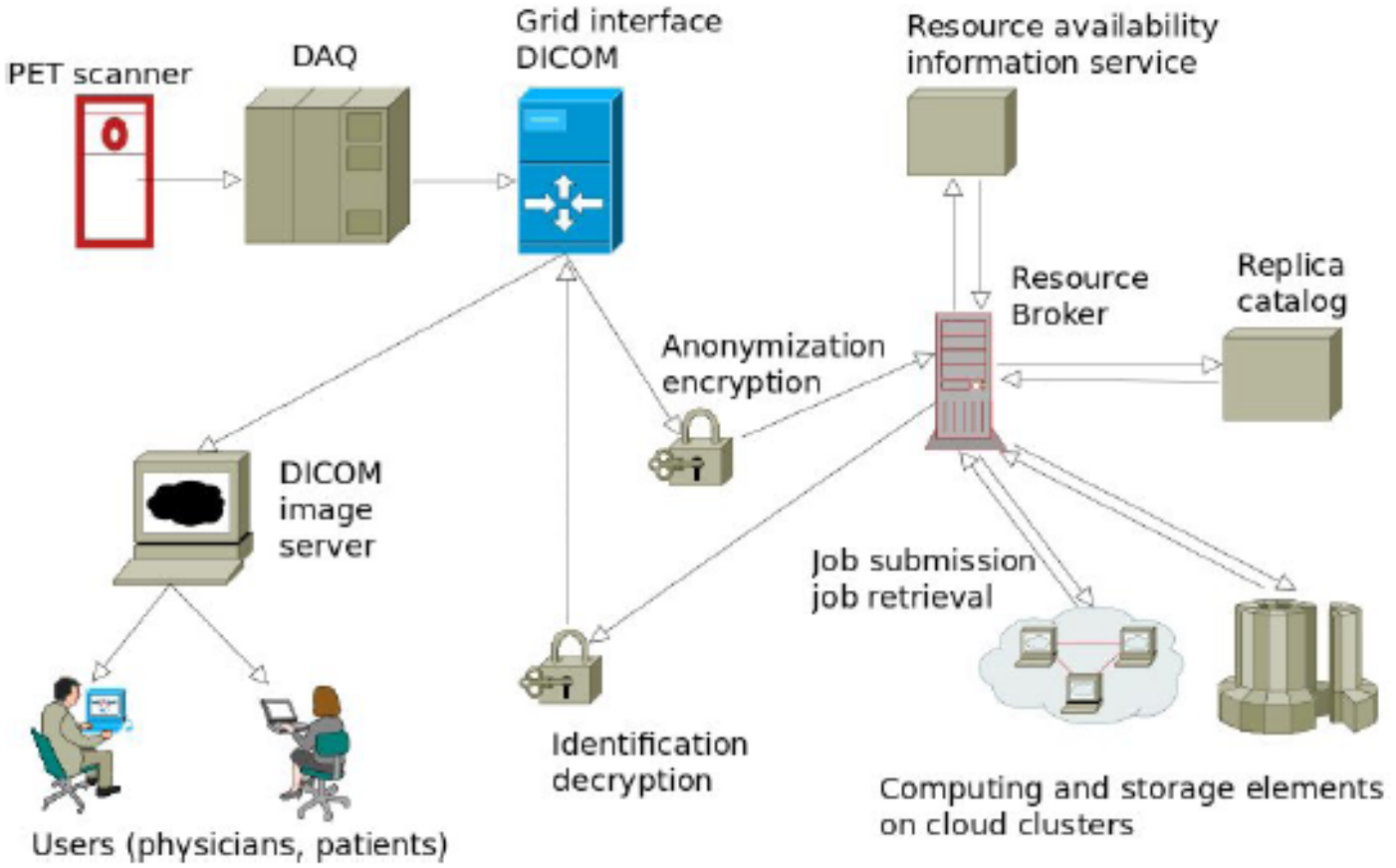


Cloud computing:

After initial recostruction in Reco RAW module, the data is being further processed in the cloud.

Cooperation with Silvermedia

GRID-based computing architecture



Picture taken from W.Wiślicki et al. Bio-Algorithms and Med-Systems 10(2014)