Shanoir: Software as a Service Environment to Manage Population Imaging Research Repositories

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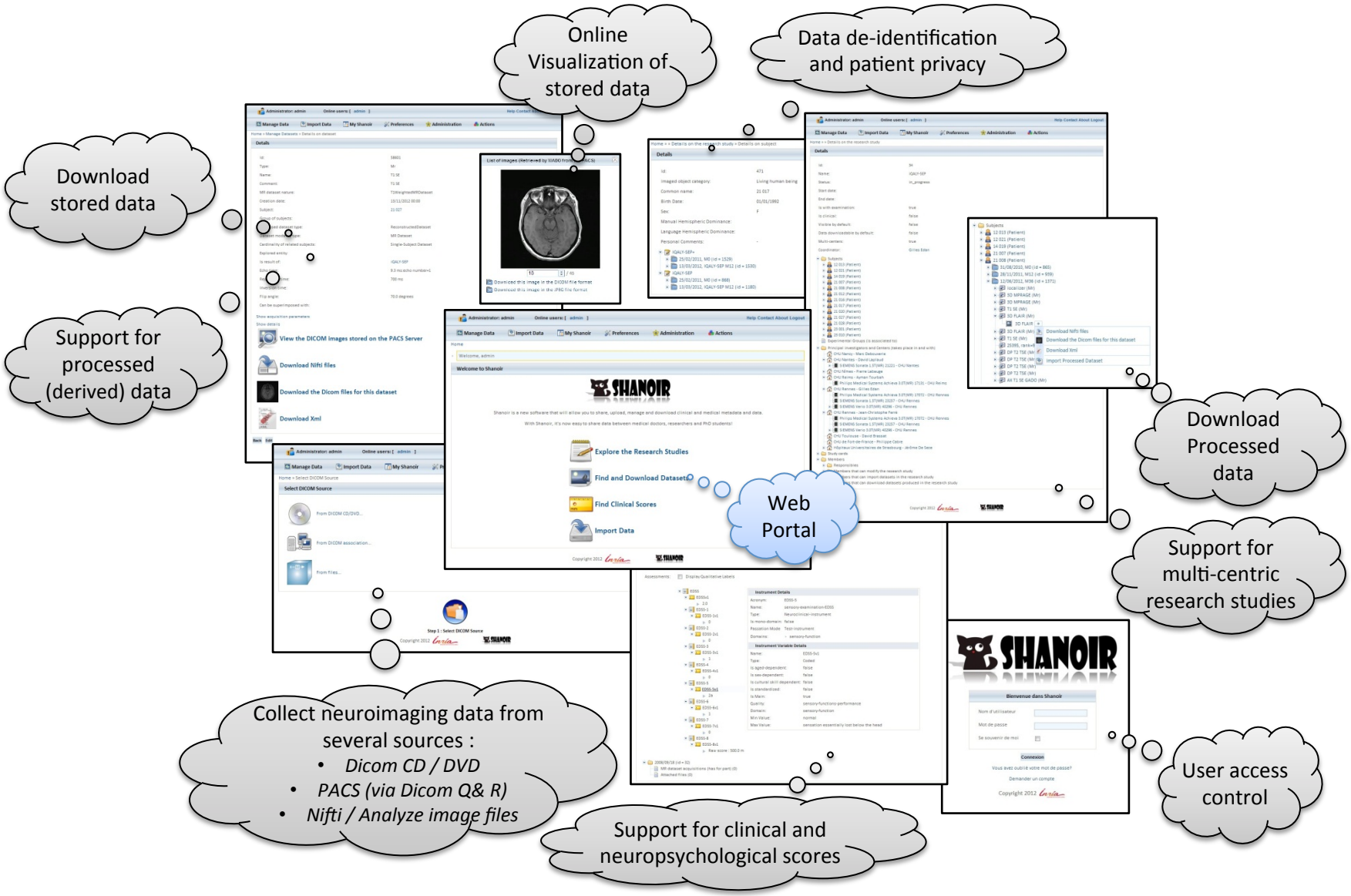
What is Shanoir ?

- An open source web application designed to:
  - Archive and Index
  - Search and Retrieve
  - Share

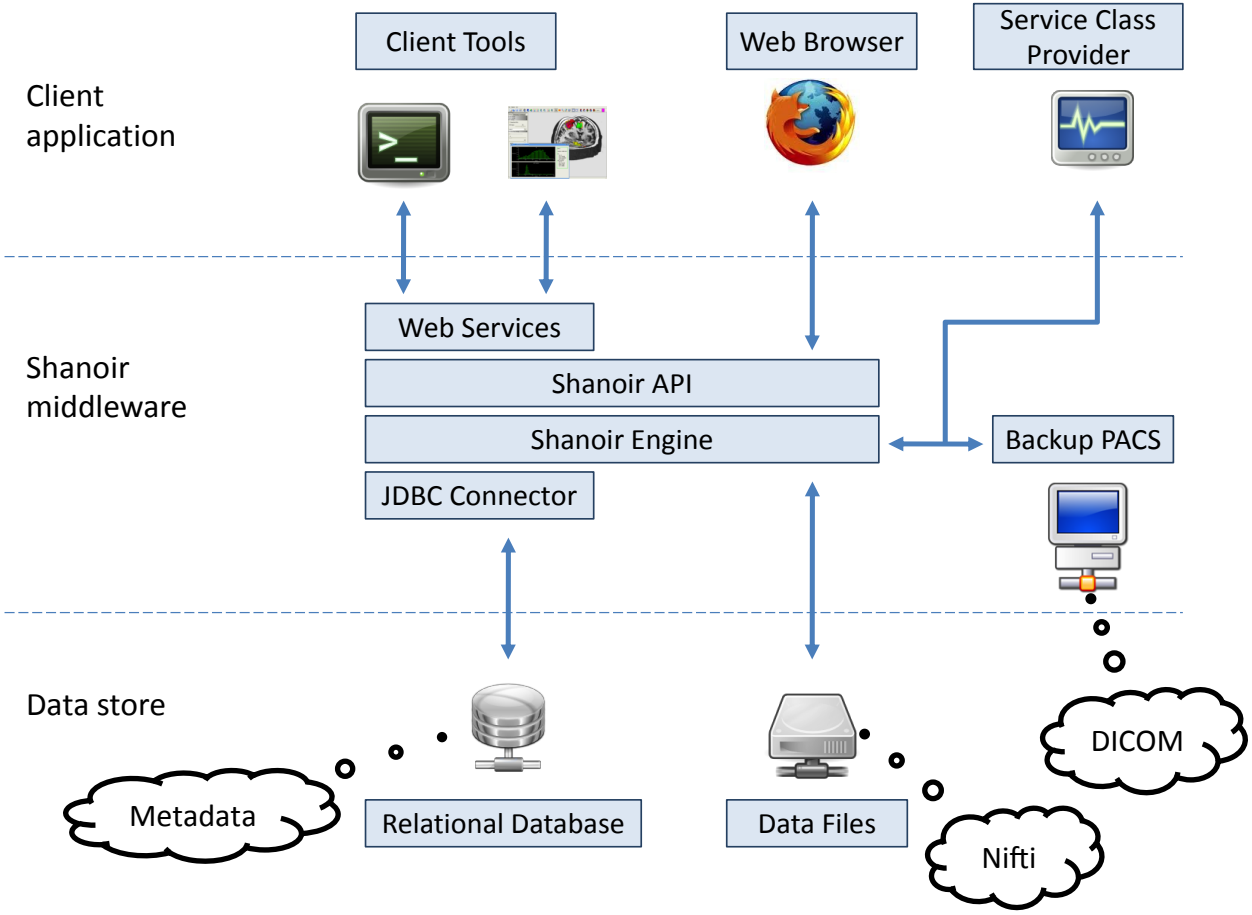
  } neuro-imaging data
- With:
  - a user-friendly **secure** web access
  - a database model build on an **ontology** [1]
    (OntoNeuroLOG, from the NeuroLOG [2] project)
- In order to:
  - Enhance data availability and integrity
  - Structure the data / Manage data provenance
  - Facilitate collaborative research works
  - Pool acquisition resources

SHAring NeurOImaging Resources
An open source web platform for population imaging



Software architecture

Shanoir is organized as a repository of neuroimaging files coupled with a relational database where additional metadata are stored.



Environment

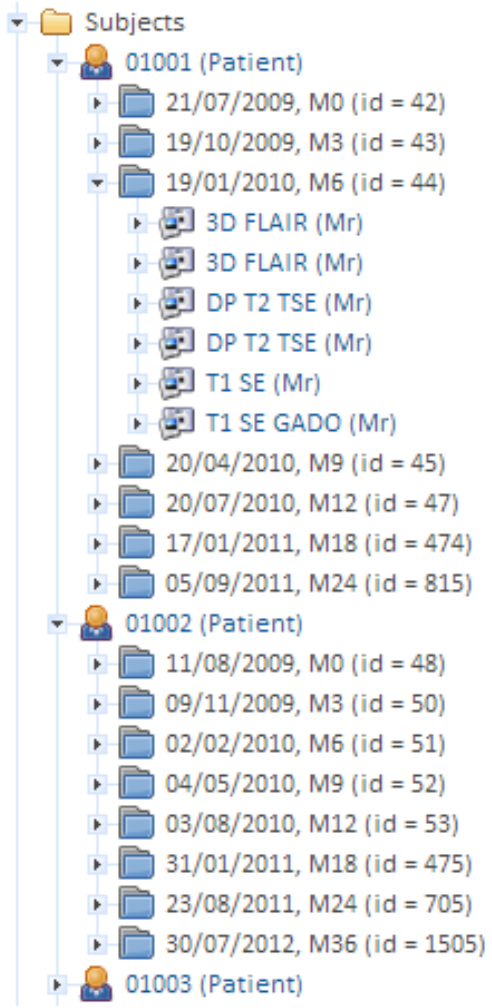
- Java Enterprise (JEE)
- JBoss Application Server (AS)
- Eclipse (as IDE)
- ANT (as build tool)
- Subversion (for version control)

JEE frameworks

- JBoss Richfaces
- JAX-WS (for web services)
- JBoss Seam
- Java Persistence API (JPA) with Hibernate 3

Data organization

- Study
  - Subject
    - Examination (date)
      - Dataset
      - Dataset
    - Examination (date)
      - Dataset
      - Dataset
  - Subject
    - Examination (date)
      - Dataset
      - Dataset
    - Examination (date)
  - …



The Study card mechanism

Purpose: Alignment of Ontology concepts to the actual imported data

- Objectives:
  - Assign in a unique semantics meta-data that are not natively in the DICOM format
    - e.g. Sequence MR Contrast (T1, T2, T2*, DP, ..), physical parameters of the MR sequence, MR head coil, parallel acquisition technique, contrast agent (Gd, …)
  - Reduce the workload to assign the eta-data for the user (defined once)
  - Allow an automatic quality control of the conformity of the data to the protocol
- How it works:
  1. The user defines a set of conditions based on DICOM tag(s) value
     (e.g. on “Serie Description”, “Protocol Name”, “Echo Time”, …)
  1. Each set of conditions corresponds to a set of rules
  2. If a serie fulfils a set conditions, the corresponding set of rules is applied

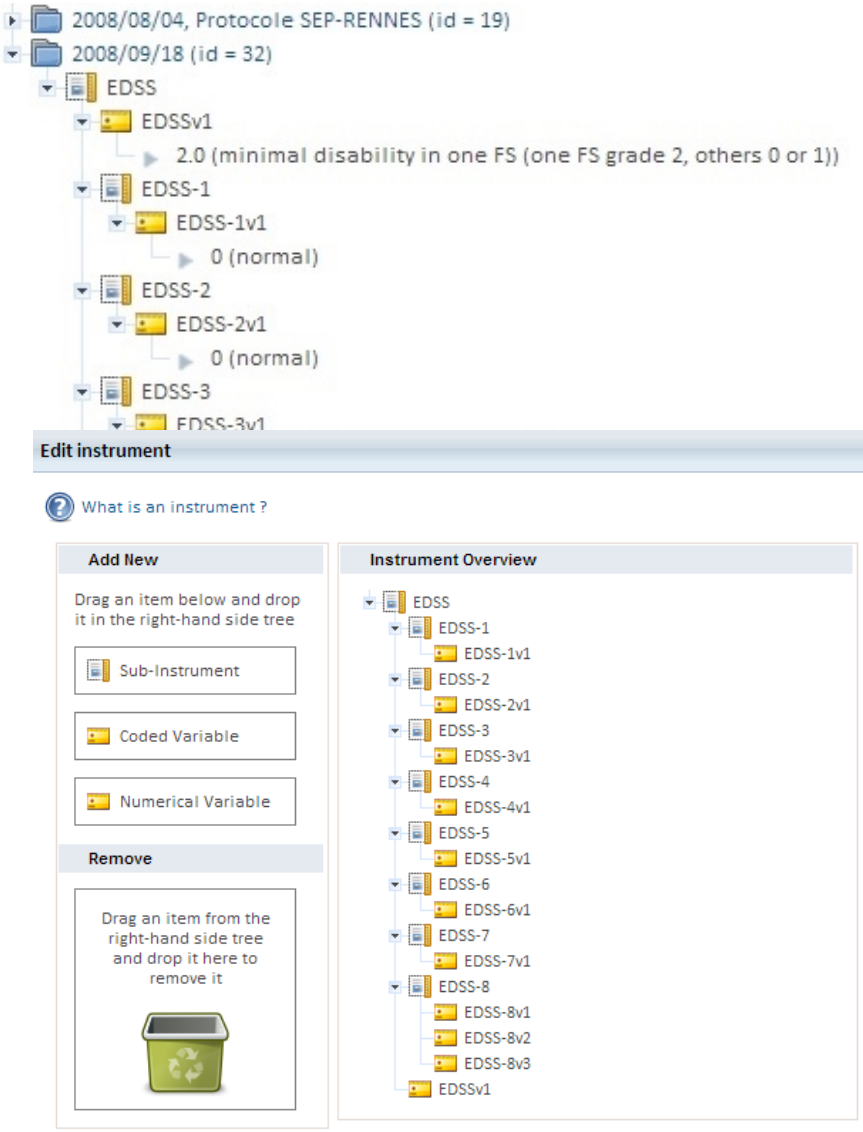
- Example :
  - **If** « Serie Description » contains « 3D T1 Gado » **then**
    - `AcquisitionContrast > T1`
    - `MrDatasetNature > T1WeightedMRDataset`
    - `ContrastAgentUsed > GADOLINIUM`
    - `MrSequencePhysics > Magnetization prepared spoiled GRE`
    - `SliceOrientationAtAcquisition > sagittal`

➥ Information you cannot find in DICOM tags, can be attached as metadata.

- Each Study card is applied during the DICOM import and depends on the study, the center and its acquisition equipment.

Clinical Scores Management in Shanoir

- Instrument-based assessments (i.e. neuropsychological tests such as **EDSS** or **MMS**) results in Clinical Scores
- Shanoir offers features for hosting such scores and assign them to the related stored image data
- Export features are available for different formats (Excel, CVS, XML…)
- The "instrument" database is extendable thanks to a user-friendly interface



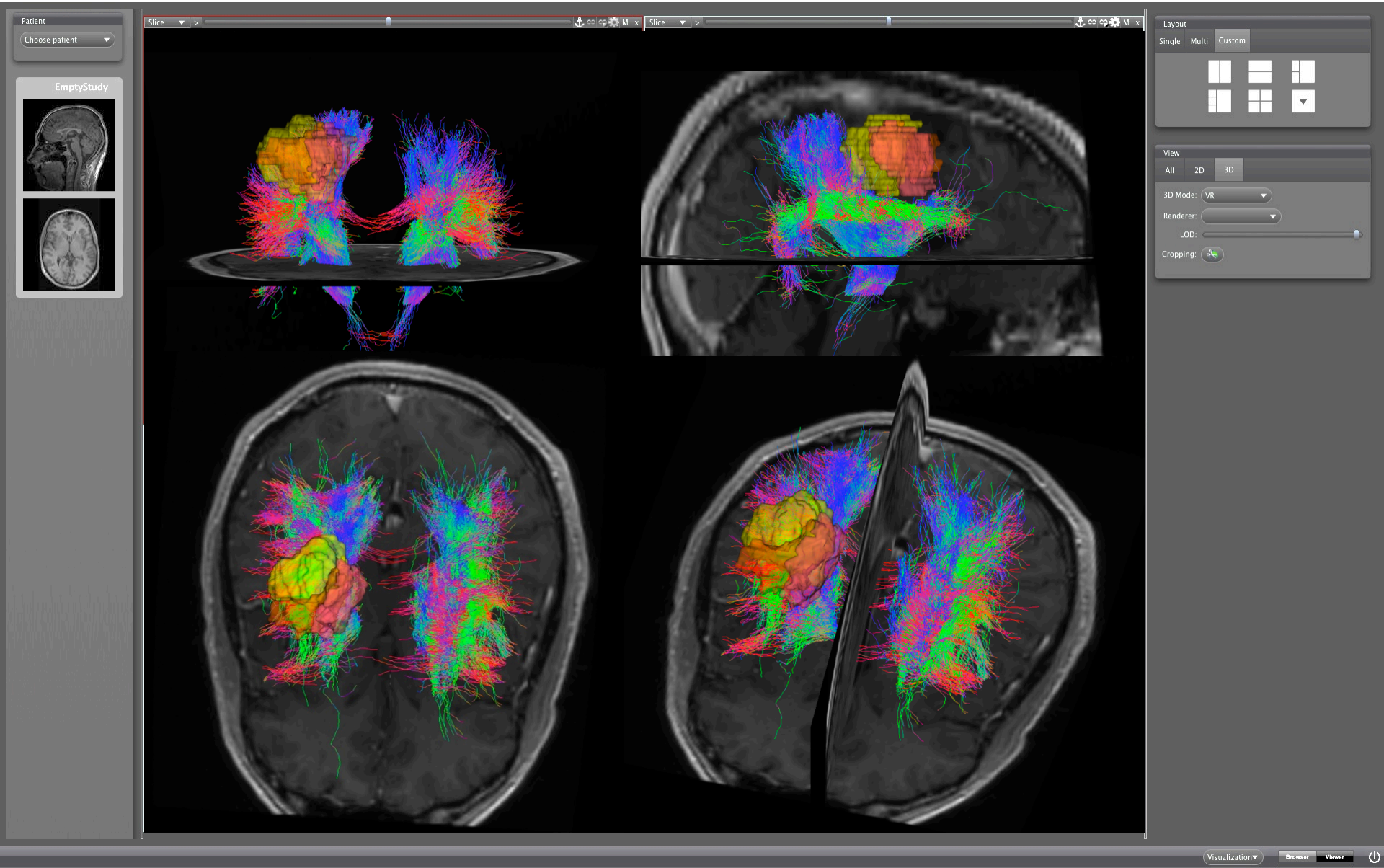
Client applications

- Client applications can query and retrieve the data from the Shanoir server through web-services (SOAP).

- Two librairies are publically available to implement this feature:
  - **ShanoirTk** (Java toolkit)
  - **QtShanoir** (C++ client) for:
    - browsing the data inside a graphical widget
    - Import derived (processed) data with registration to the source images, with assignment of specific semantic concepts (i.e. “Processing instrument”)
    - QtShanoir has been integrated as a plug-in in MedInria[3], for advanced image processing software.

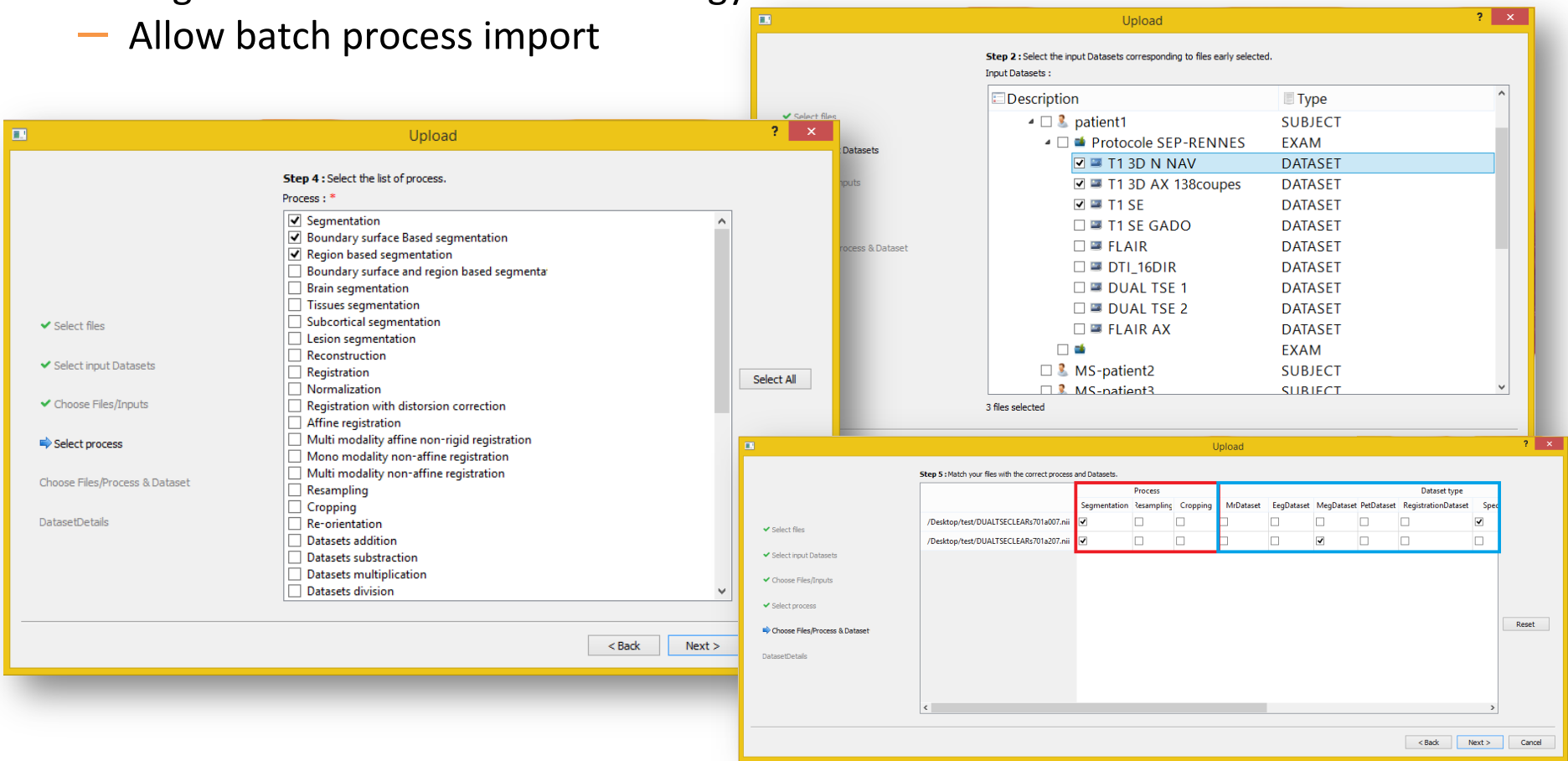
[3] **MedInria** : http://med.inria.fr/

Qt SHANOIR in MedInria



SHANOIR: Import Derived Data

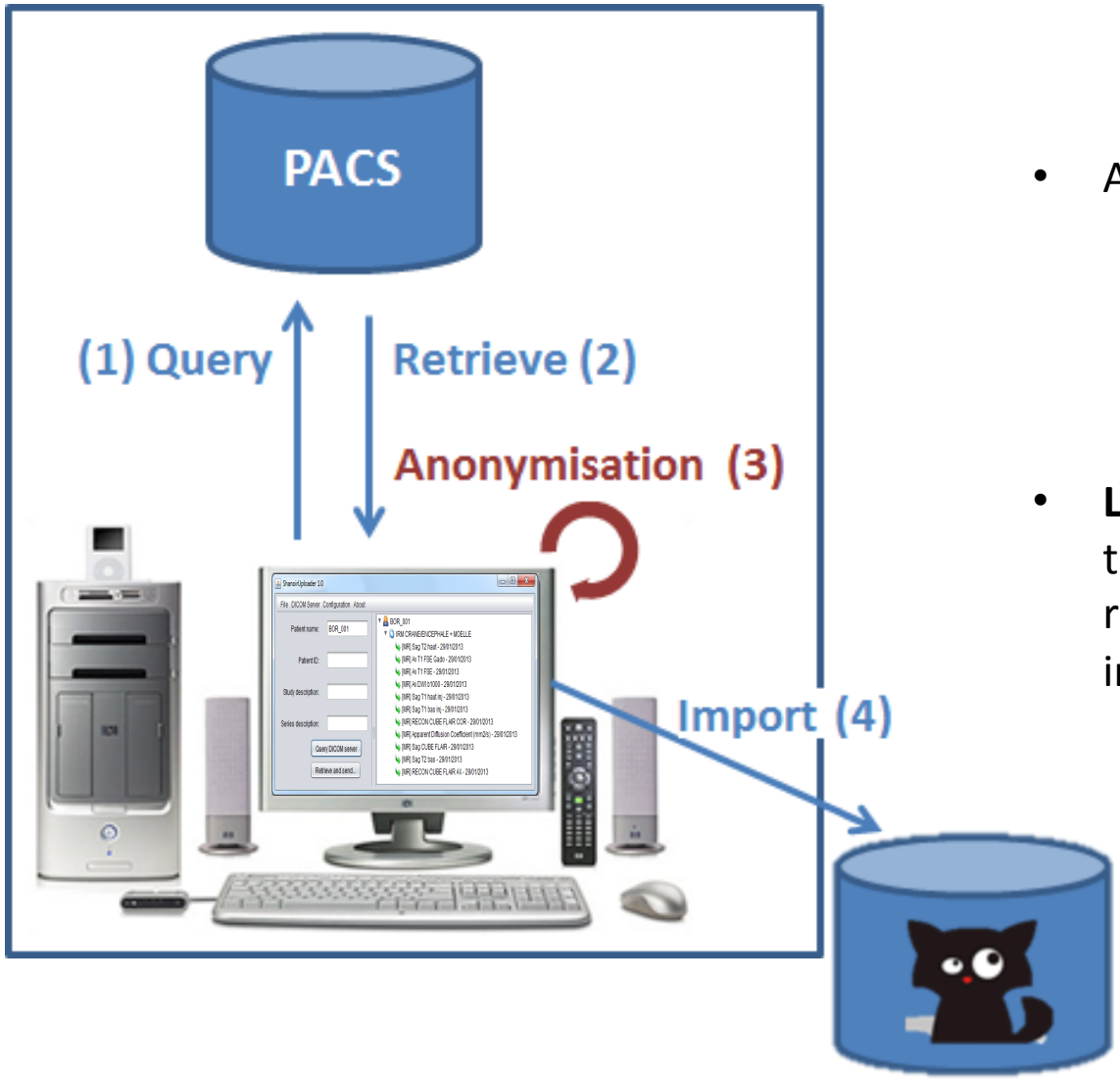
- Objective
  - Import processed data sets
  - Register the derived data to the source one
  - Align the meta-data to the ontology
  - Allow batch process import



Shanoir development Roadmap

- **ShanoirUploader** : make the import easier and safer
- **iShanoir** : iOS application for Ipad, increase the portability
- **Apache/SOLR integration**: makes query/ retrieve easier

ShanoirUploader



Functionalities

- Installed on the desktop
- Implemented with Java Web Start (JWS)

- At the MR console:
  - **(1)** Query & Retrieve from local PACS
  - Upload local data stored on the PACS **(2)**
  - On site Anonymization **(3)**
  - Storing the anonymized data to the Shanoir server **(4)**
- **Later on**: Et plus tard, connect to the Shanoir server to complete the registration of the data and resume import.

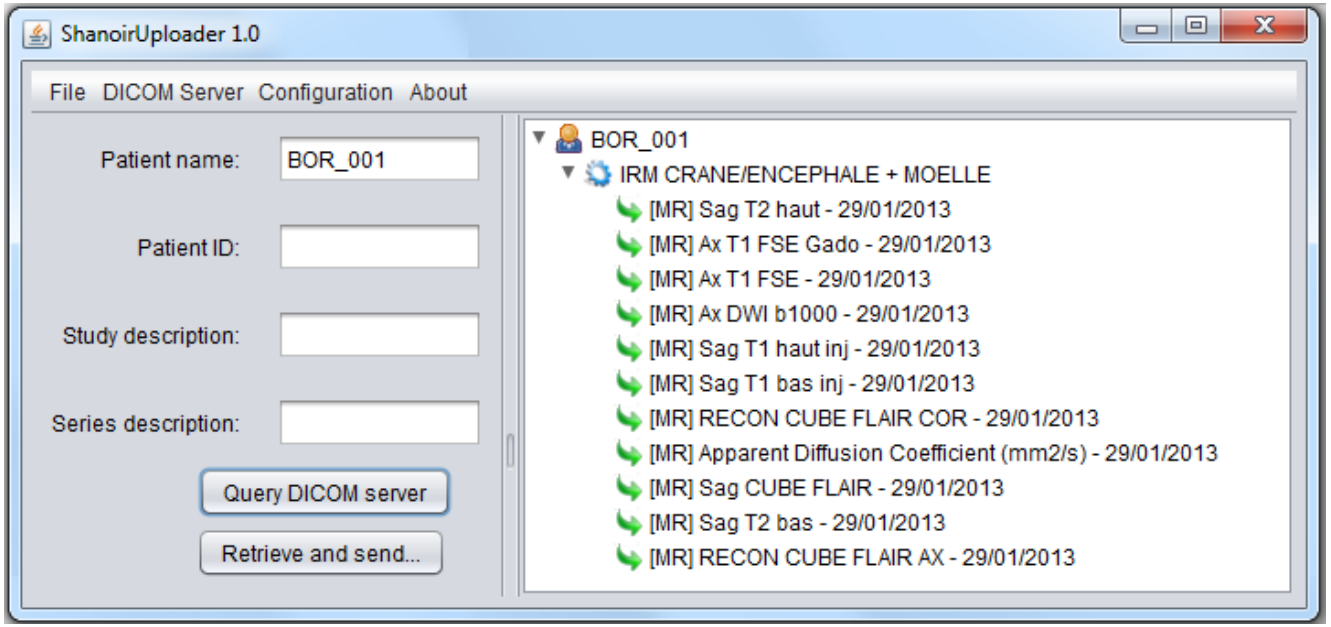
Advantages:

- Easy and Fast
- Can be done on packs of data
- Can be performed by a technician
- Secured solution accredited by Hospitals IT managers

ShanoirUploader

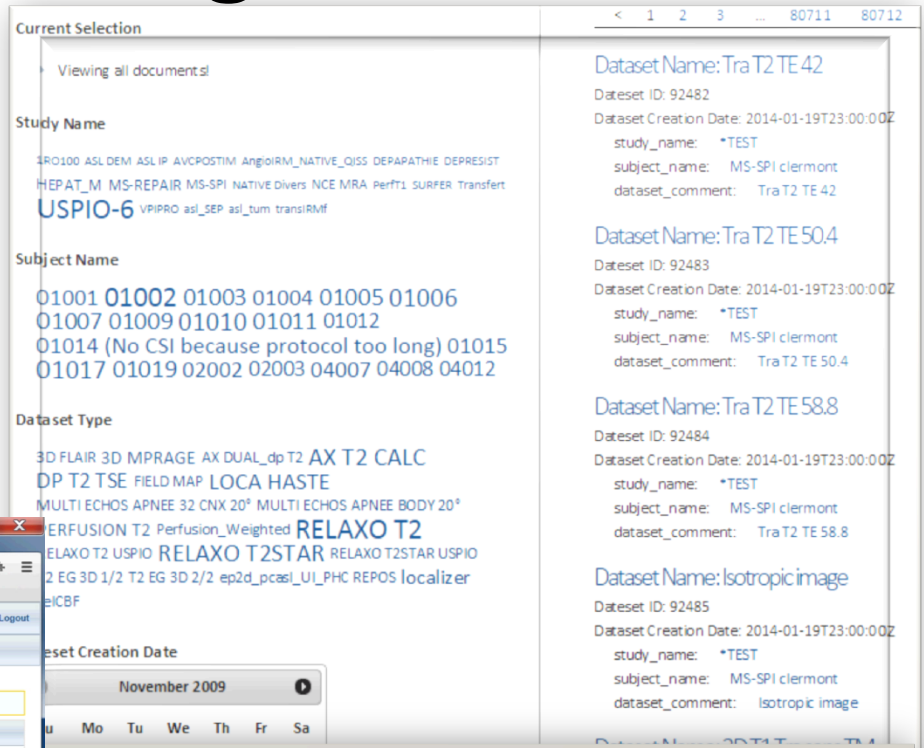
- Installed on the desktop
- Implemented with Java Web Start (JWS)
- Query & Retrieve from any PACS

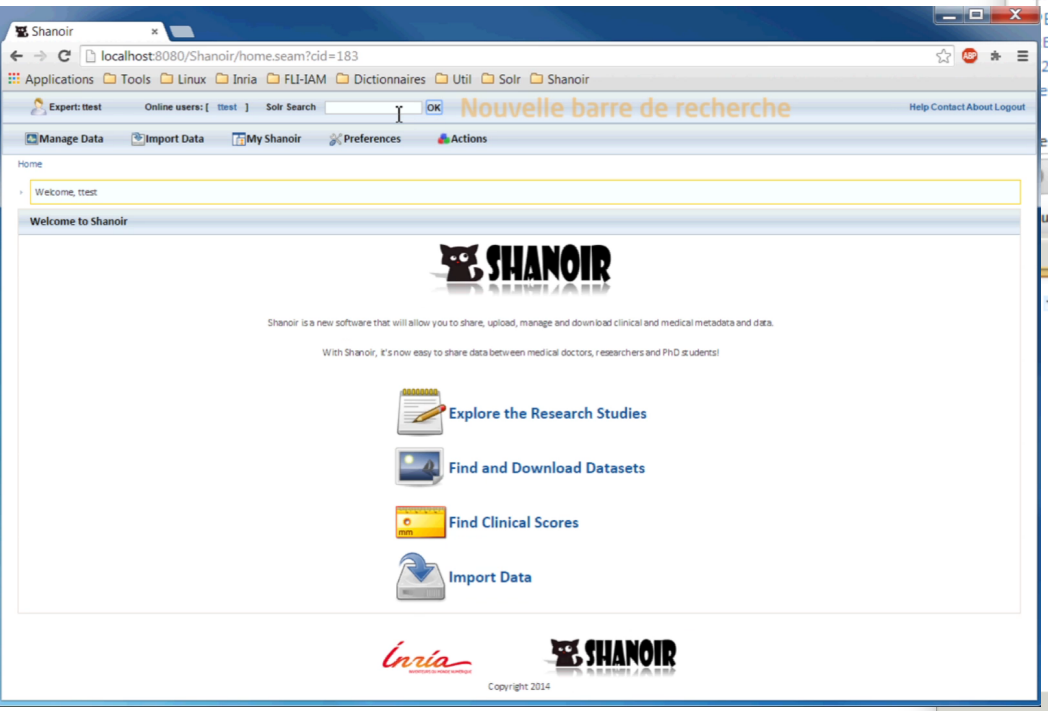
- Futur functionalities:
  - Choosing local file for import
  - Drag-and-Drop of CD-ROMs
  - Local anonymization
  - Local NIfTI conversion
  - Local StudyCard changes

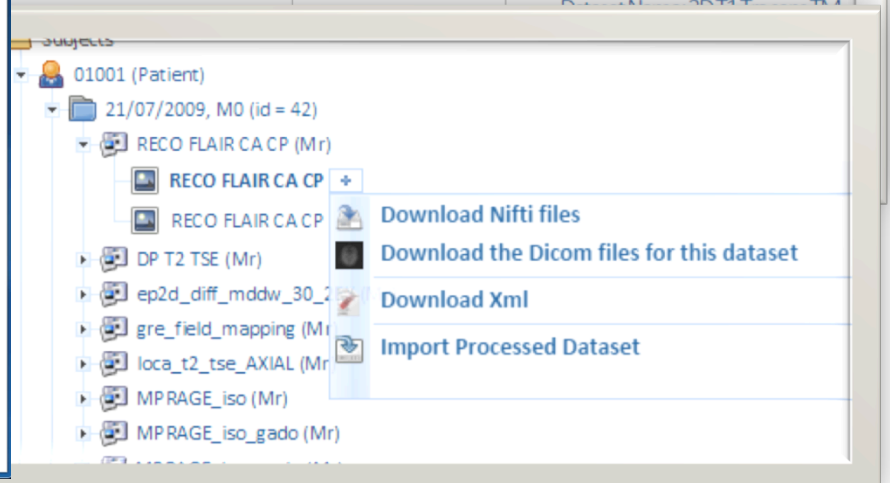


Shanoir Integration

- **Motivation**
  - Allow easy indexing and search of the data
  - Allow a direct mapping between Shanoir ontology and SOLR catalogue
  - Allow easy batch download
  - Ease Interoperability between Shanoir database and other system (e.g. FLI-IAM interoperability project)







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Work in Progress: Shanoir Quality Control

Home » » Details on the research study

Quality Control

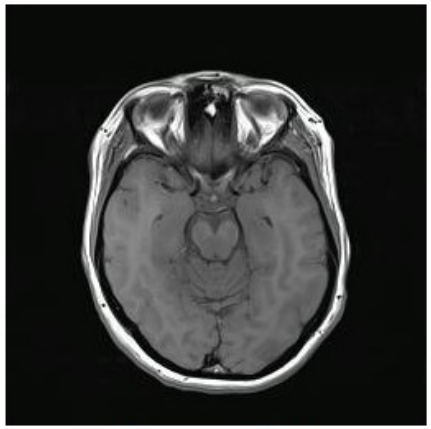
Quality cherckers : shannoun ; fcotton

Automatic QC results

Parameters	Range	Value	Flag
FOV	240-260	250	
Matrice	240-260	250	
Nombre de coupes	46	46	
Epaisseur de coupes (mm)	3	3	
Gap (mm)	0	0	
Technique	TSE-FE	TSE-FE	
TE (ms)	15-30/80-120	10-100	
TR (ms)	>3800	3500	
TI (ms)			
Taille voxel (mm3)	<1x1x3	1x1x3	

Sequence

DUAL TSE



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Download this image in the DICOM file format
Download this image in the JPEG file format

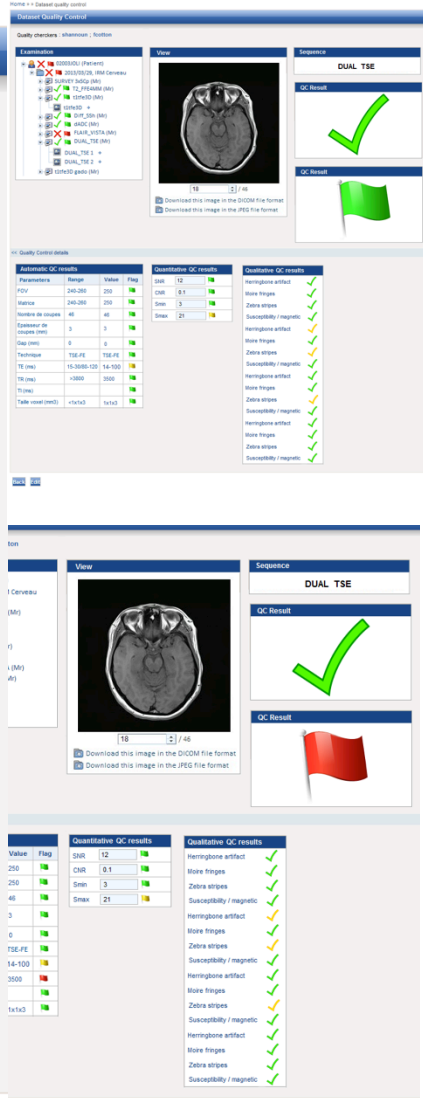
Quantitative QC results

SNR	53
CNR	32
Smin	
Smax	

Qualitative QC results

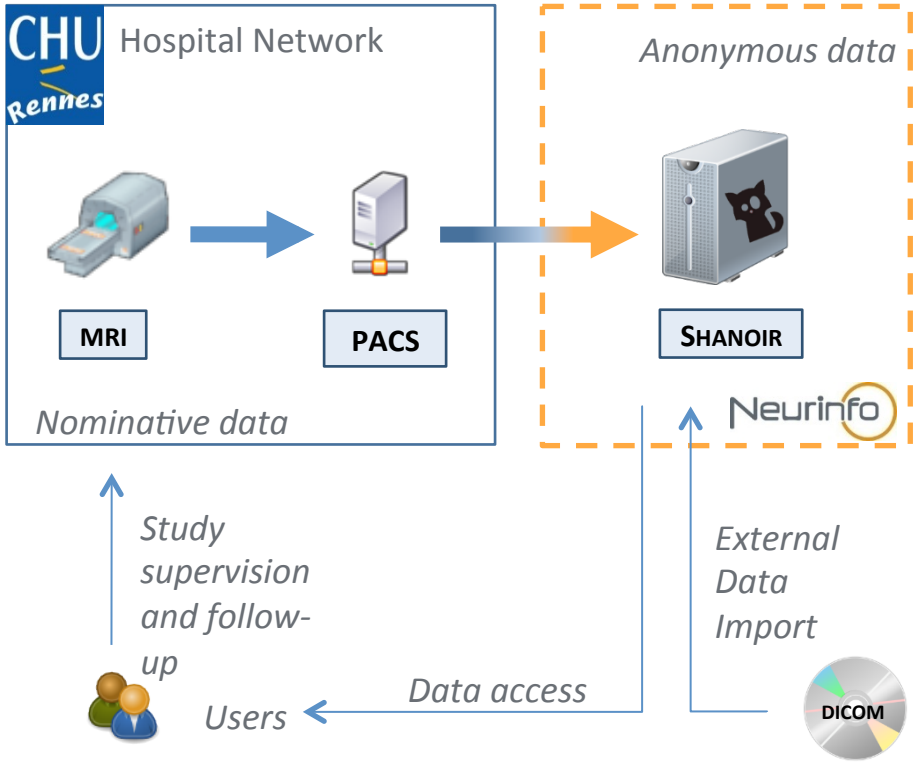
Herringbone artifact	✓	✓	✗
Moire fringes	✓	✓	✗
Zebra stripes	✓	✓	✗
Susceptibility / magnetic	✓	✓	✗
Herringbone artifact	✓	✓	✗
Moire fringes	✓	✓	✗
Zebra stripes	✓	✓	✗
Susceptibility / magnetic	✓	✓	✗
Herringbone artifact	✓	✓	✗
Moire fringes	✓	✓	✗
Zebra stripes	✓	✓	✗
Susceptibility / magnetic	✓	✓	✗
Herringbone artifact	✓	✓	✗
Moire fringes	✓	✓	✗
Zebra stripes	✓	✓	✗
Susceptibility / magnetic	✓	✓	✗

Cancel Update



Shanoir@Neurinfo server

Neurinfo* is a **research** platform, from the University of Rennes I, located at the University Hospital of Rennes. It operates a Siemens 3T Verio™ MRI and a data center (50TB, 250 cores) and uses **Shanoir** to manage and publish its data as well as data from **multicentric studies**.



31 (*37*)	Centers (*Equipments*)
127 (*52*)	Users (*active*)
60	Studies
2228	Subjects
3157	Examinations
114 441	Datasets
3099 GB	Raw & Processed Data
20 GB	Meta-Data

Stats Jan. 2015

* **Neurinfo** : http://www.neurinfo.org

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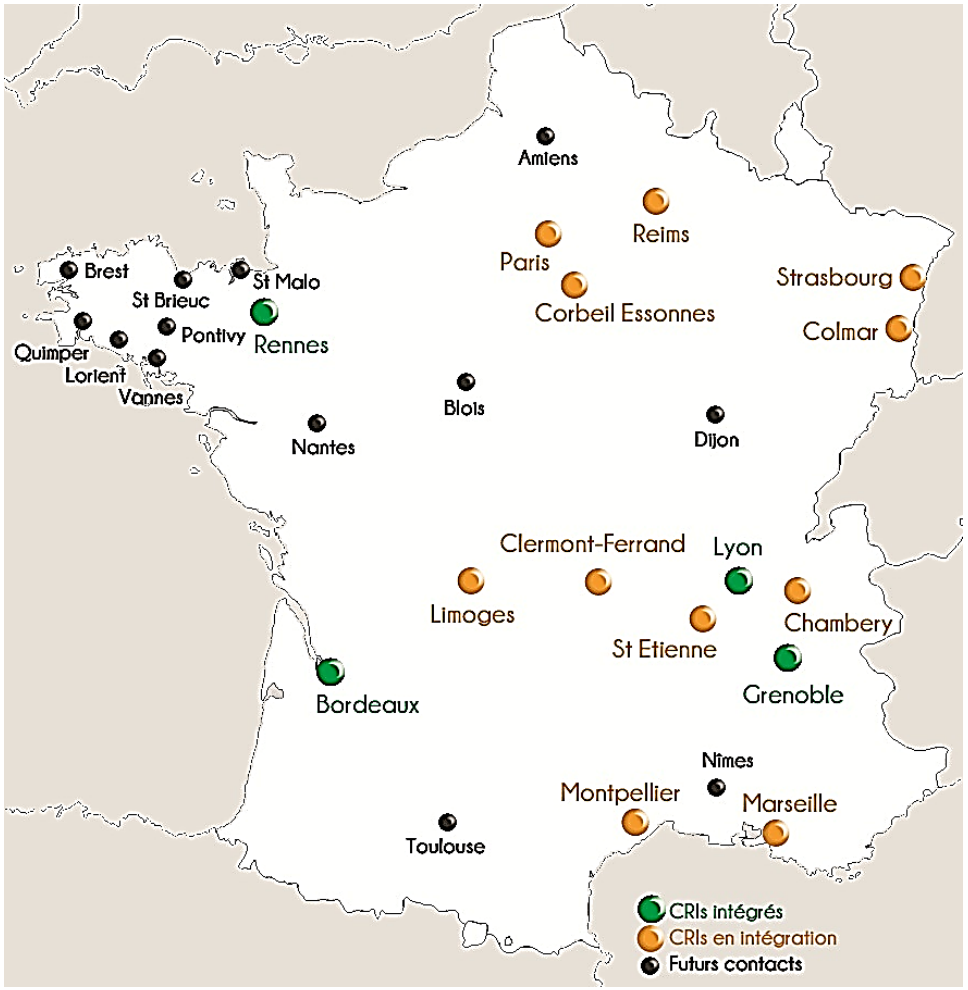
OFSEP
Observatoire Français de la Sclérose en Plaques

Shanoir@OFSEP server



OFSEP is a nationwide, **clinical**, cohort, representing about half of the MS patients population living in France, for a **longitudinal follow-up** (clinical, biological and neuroimaging data). **Shanoir** has been chosen to be the OFSEP neuroimaging data management platform

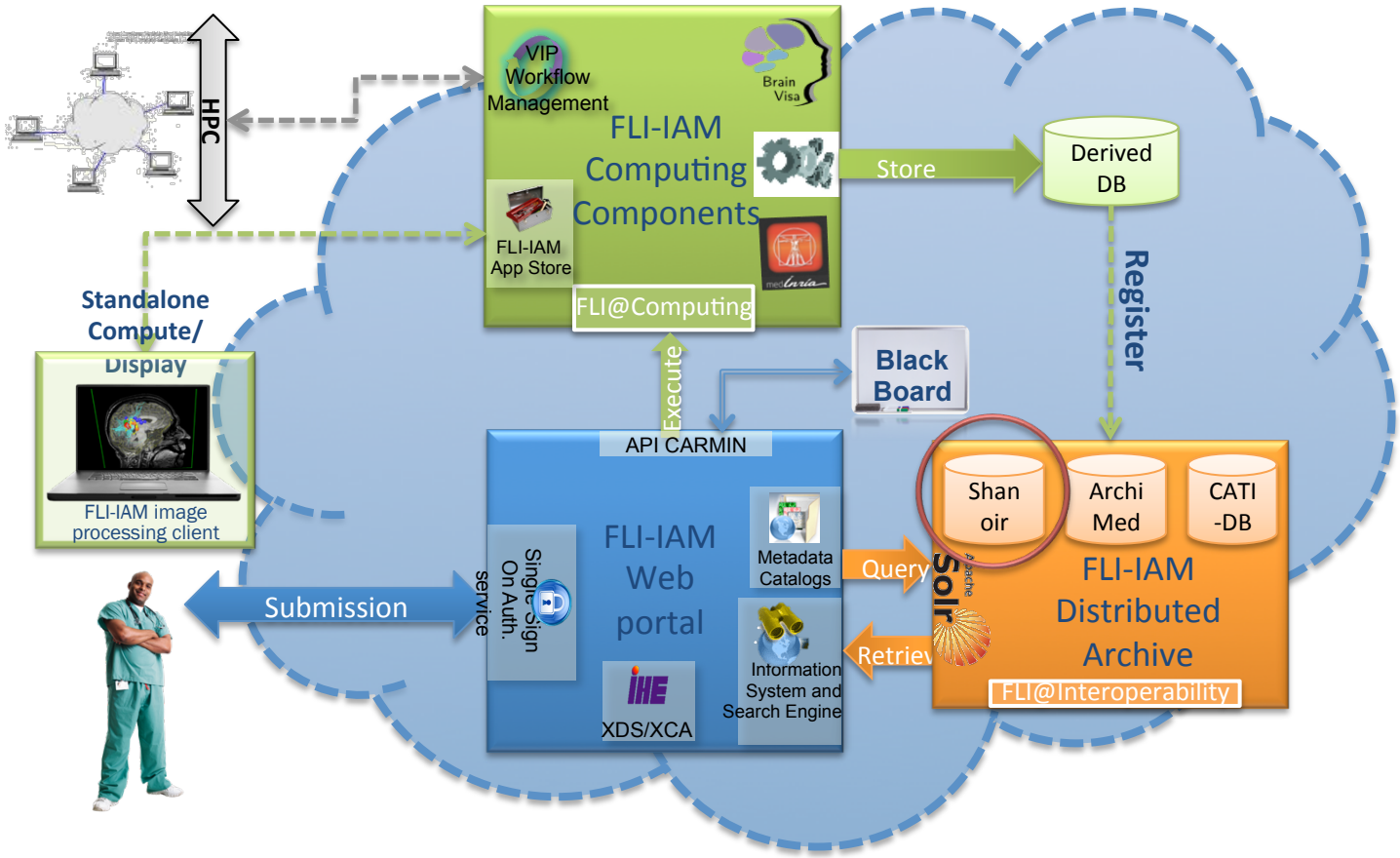
MR models diversity in OFSEP

8	**Siemens - Aera 1,5T**
7	**Philips - Achieva 3T**
2	General Electric - DISCOVERY MR750w 3T
2	Philips - Ingenia 1,5T
2	Siemens - Avanto 1,5T
2	Siemens - Skyra 3T
1	General Electric - Signa HDxt 3T
1	Philips - Achieva 1,5T
1	Philips - Ingenia 3T
1	Siemens - Espree 1,5T
1	Siemens - Spectra 3T
1	Siemens - Symphony Tim 1,5T
1	Siemens - Trio 3T
1	Siemens - Verio 3T

Inria Inserm Université de Rennes 1 cnrs

Shanoir@FLI-IAM

FLI* is research infrastructure aiming to build an organised and standardized network for in-vivo imaging in France. The IAM node is a consortium of teams that set up an infrastructure of in-vivo image storage and processing.



*https://project.inria.fr/fli/en

Shanoir Major functionalities

- Data organization
- Study card mechanism
- Clinical scores
- Clients applications

Undergoing large scale projects

- Neurinfo imaging platform (*31 sites connected*)
- OFSEP's cohort in MS (*35 sites connected*)
- France Life Imaging (FLI-IAM) national infrastructure for in-vivo imaging

Thank you for your attention !