

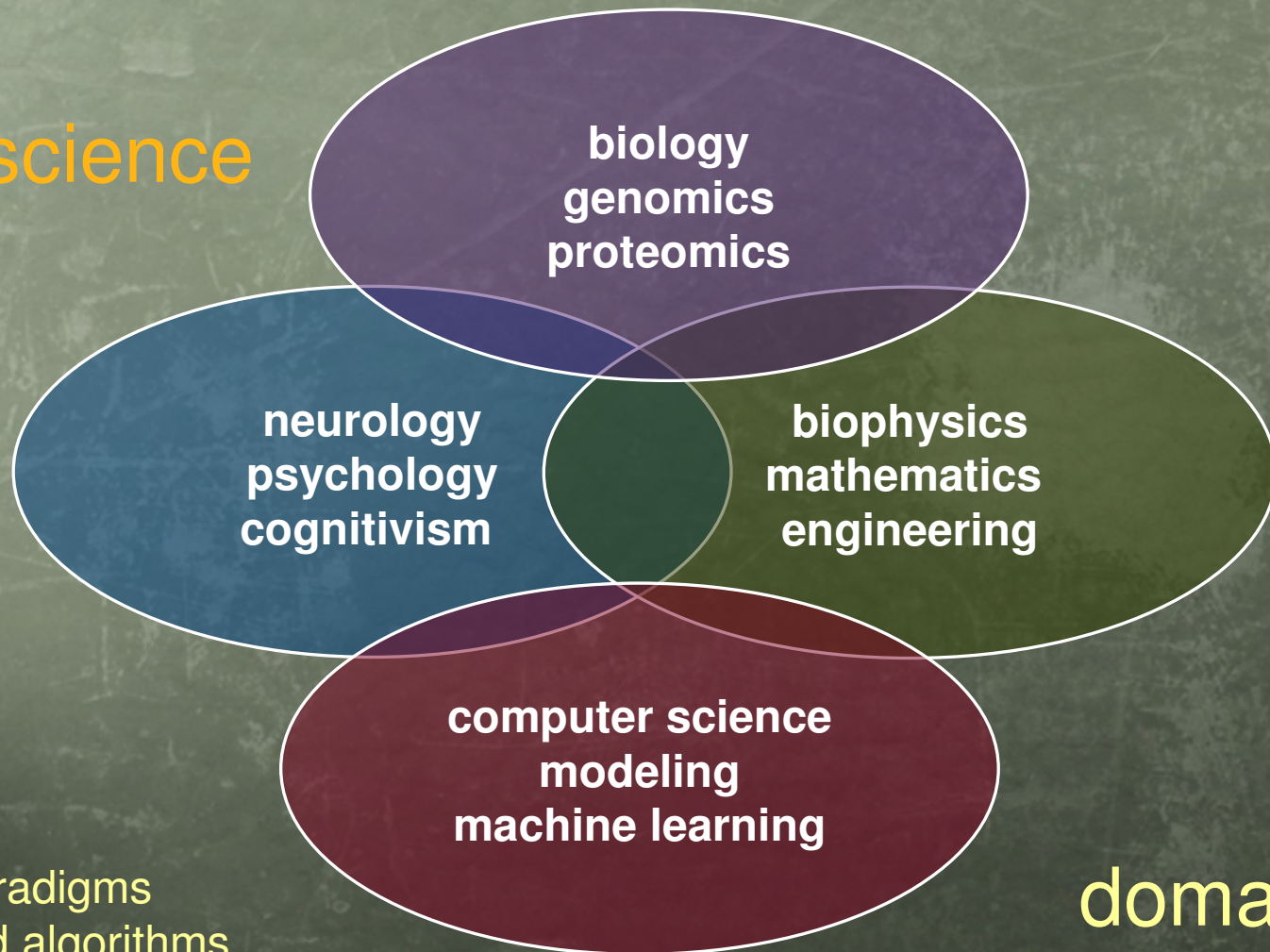


Methods and tools for a collaborative environment supporting experiments in neuroscience

Andrea Schenone

Department of Communication, Computer and System Sciences
University of Genova

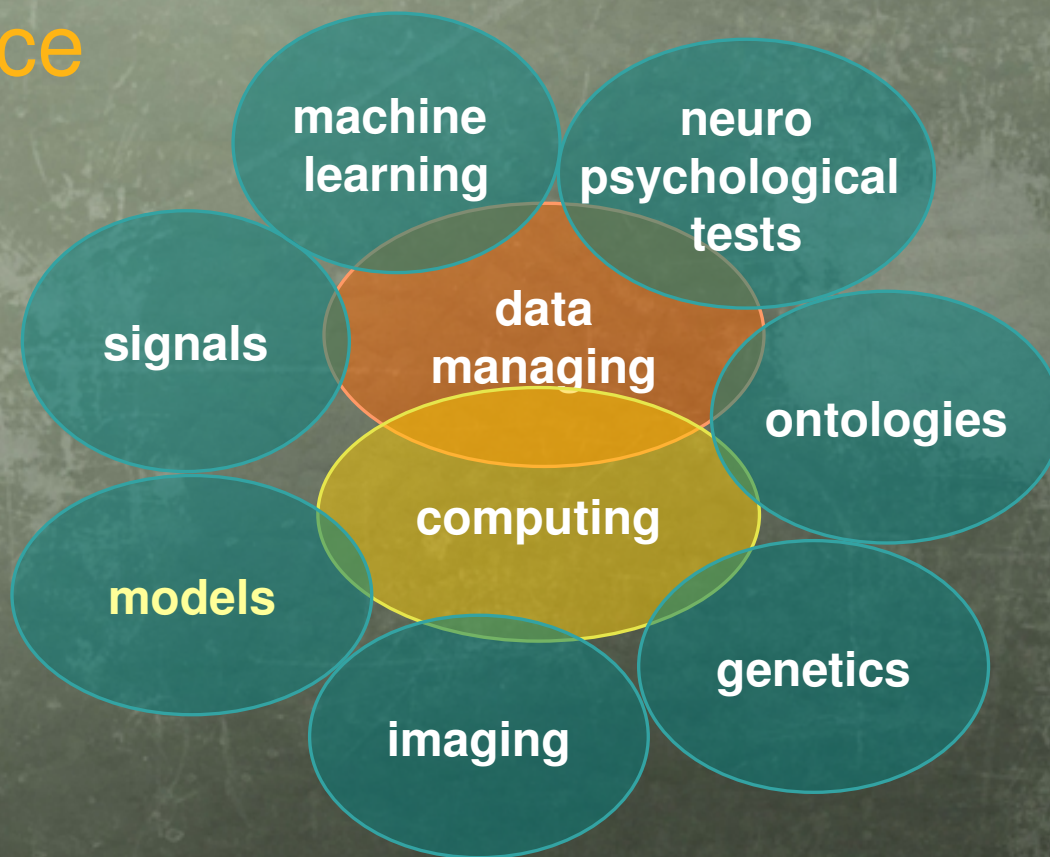
Neuroscience



Scientific paradigms
Methods and algorithms
Data and techniques

domain
issues

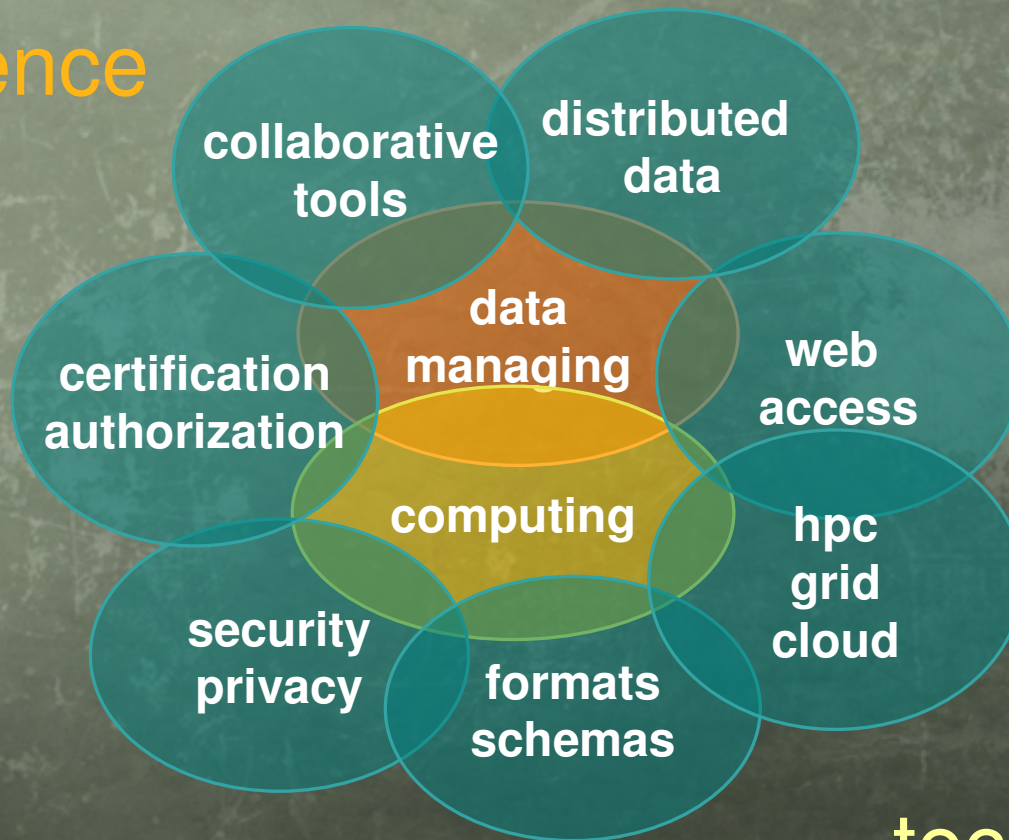
Neuroscience



Formats
Schemas
Procedures
Semantics

data
issues

Neuroscience



Methods
Tools
Software environments

technology
issues

Experiments in neuroscience

Multiscale approach

Multimodal analysis

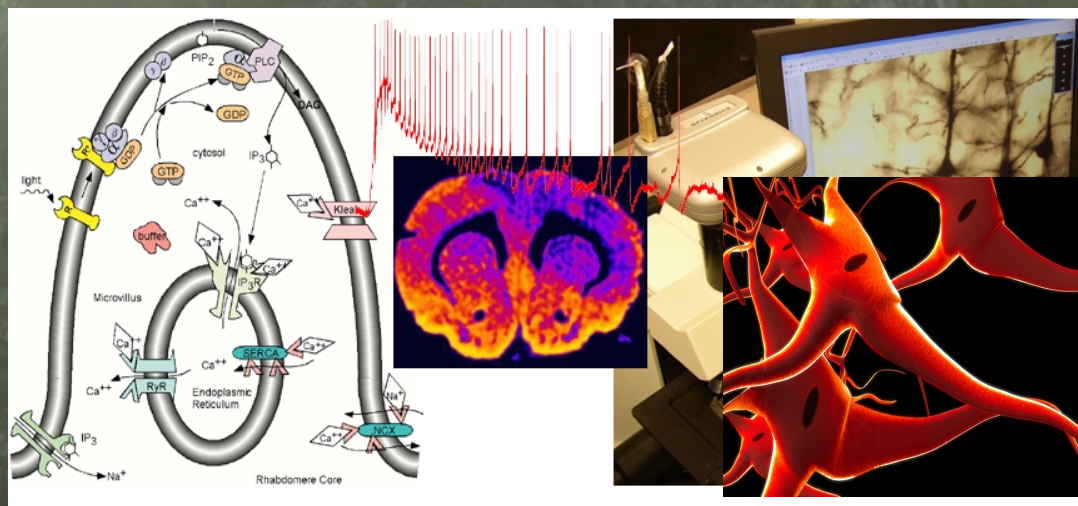
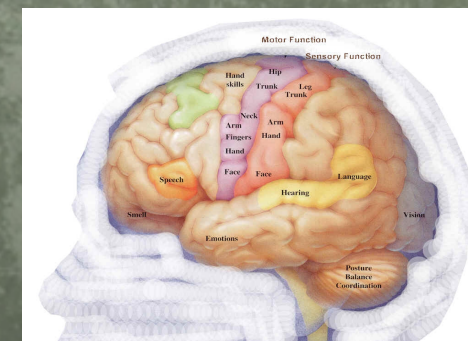
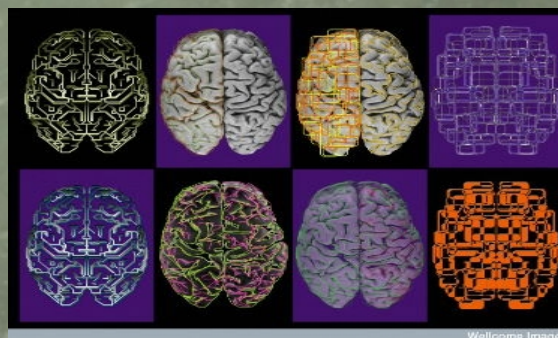
Multicentric data

Collaborative tools

Extensibility requests

Scalability issues

Complexity



Collaborative environments in neuroscience

Clinical applications

- Computer Assisted Diagnosis
- Support to surgery
- Time series analysis
- Clinical Trials

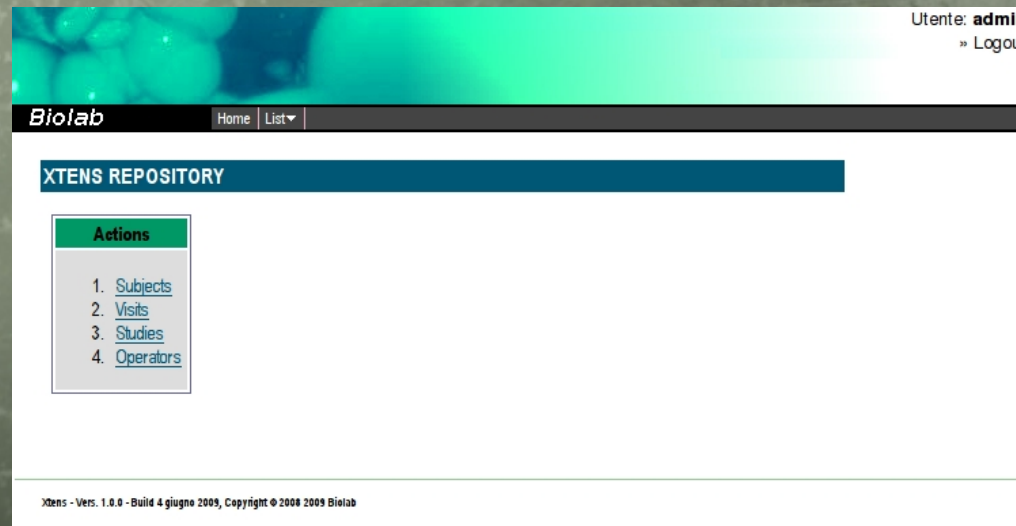
Research applications

- Retrospective analysis
- Algorithms testing
- Models validation
- Activation studies
- Definition of biological markers
- Statistical models

All these challenges need a lot of requirements to be satisfied

XTENS (eXTensible Environment for NeuroScience)

Web/Grid Portal
Repository
Application



Multipurpose Taxonomic Structure (process, event)
Complete description of relationships between data and actions

Relationships

Decoupling repository and application

Portal Web-based access

Multimodal / multicentre data management

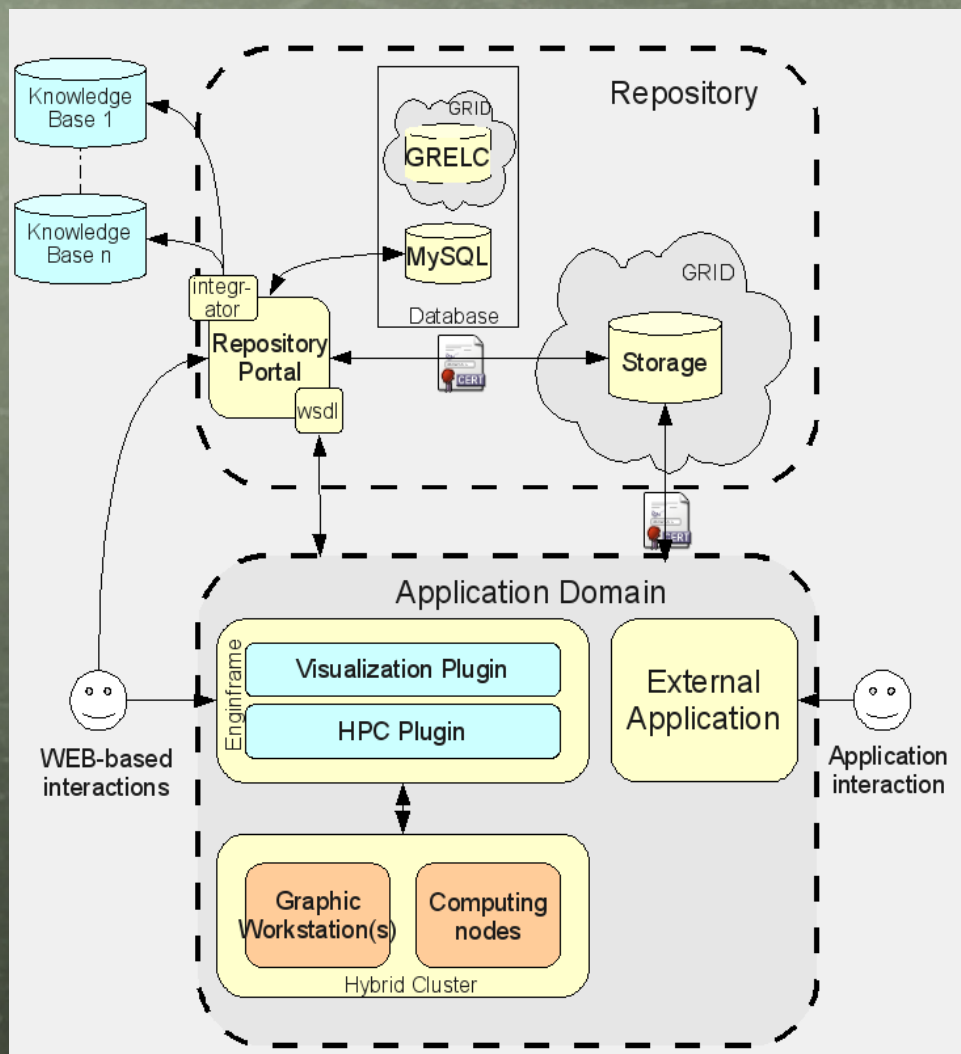
Local / remote visualization

Decoupling hardware and software

Software as a Service approach

Distributed data management

Virtualizing devices



Technology

Repository Domain:

- * Repository portal
- * Database
- * Grid Storage

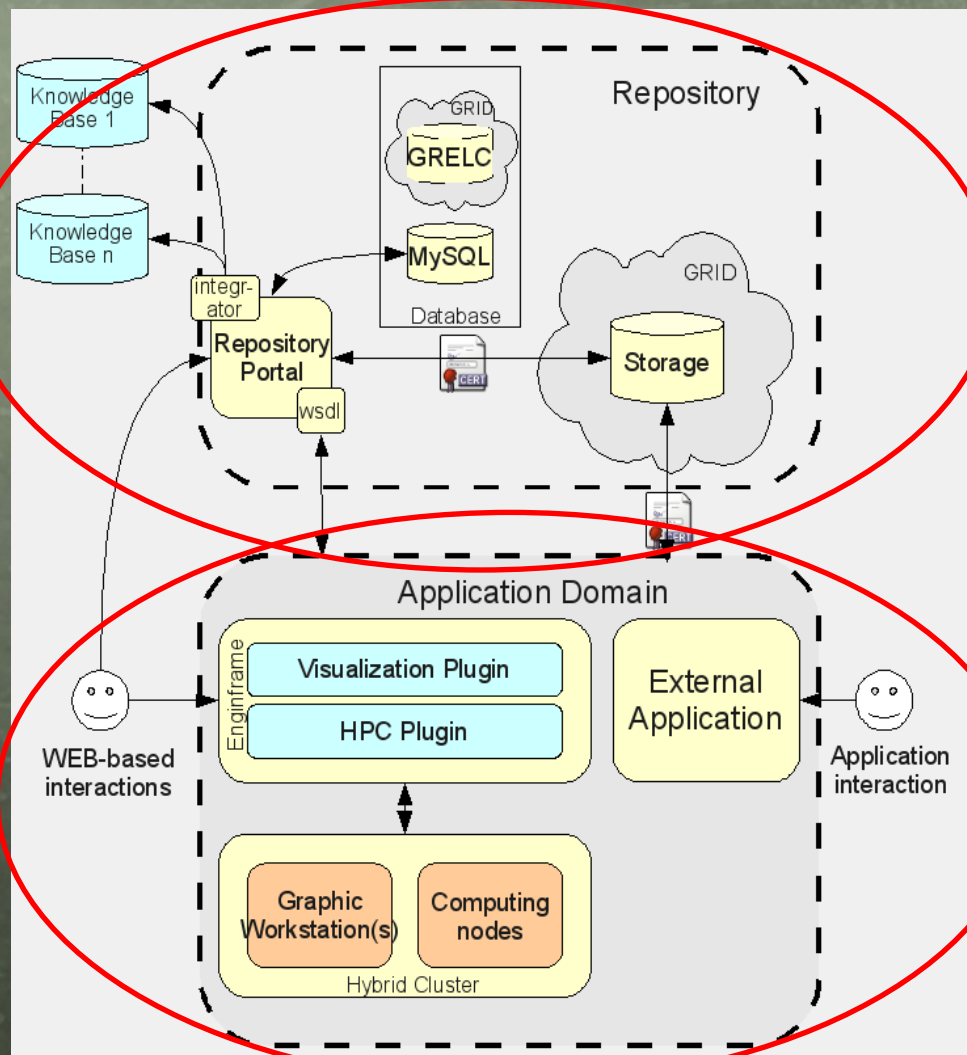
Xengine Framework

Application Domain:

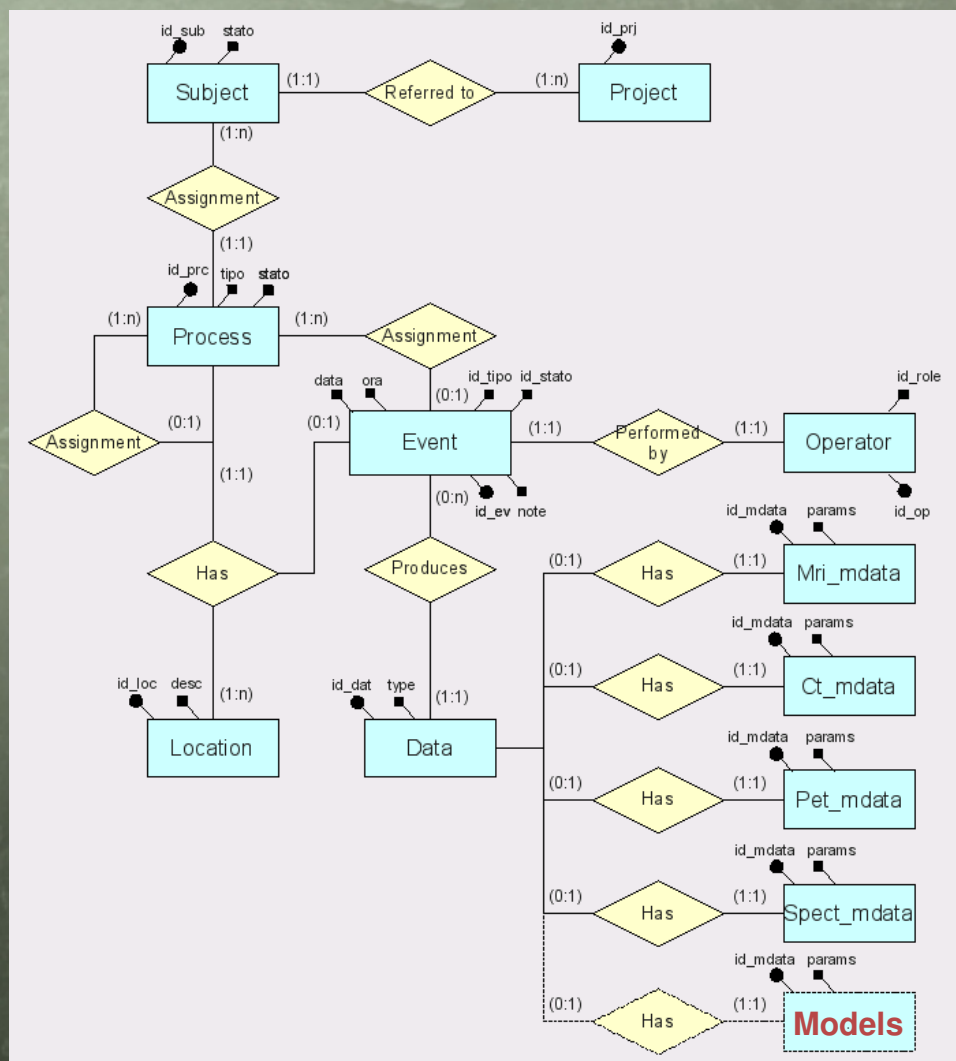
- * Application portal
- * External applications
- * Hardware devices
- * Grid-portal with plugins

EnginFrame

Data & computational Grid
Advanced hardware resources



XTENS schema



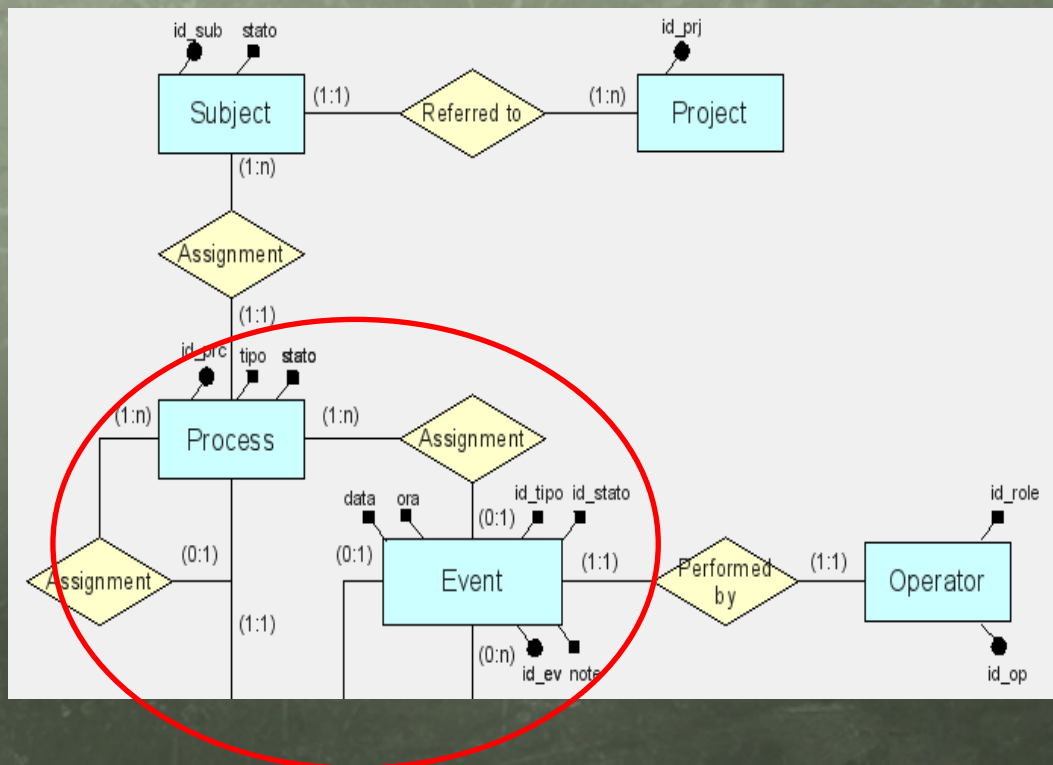
Need for data extensibility

XCEDE schema
(XML-based Clinical and
Experimental Data Exchange)

BIRN (Biomedical Informatics
Research Network)

- Projects
- Subjects
- Operators
- Visits
- Locations
- Studies
- Acquisitions
- Results
- Other

XTENS schema



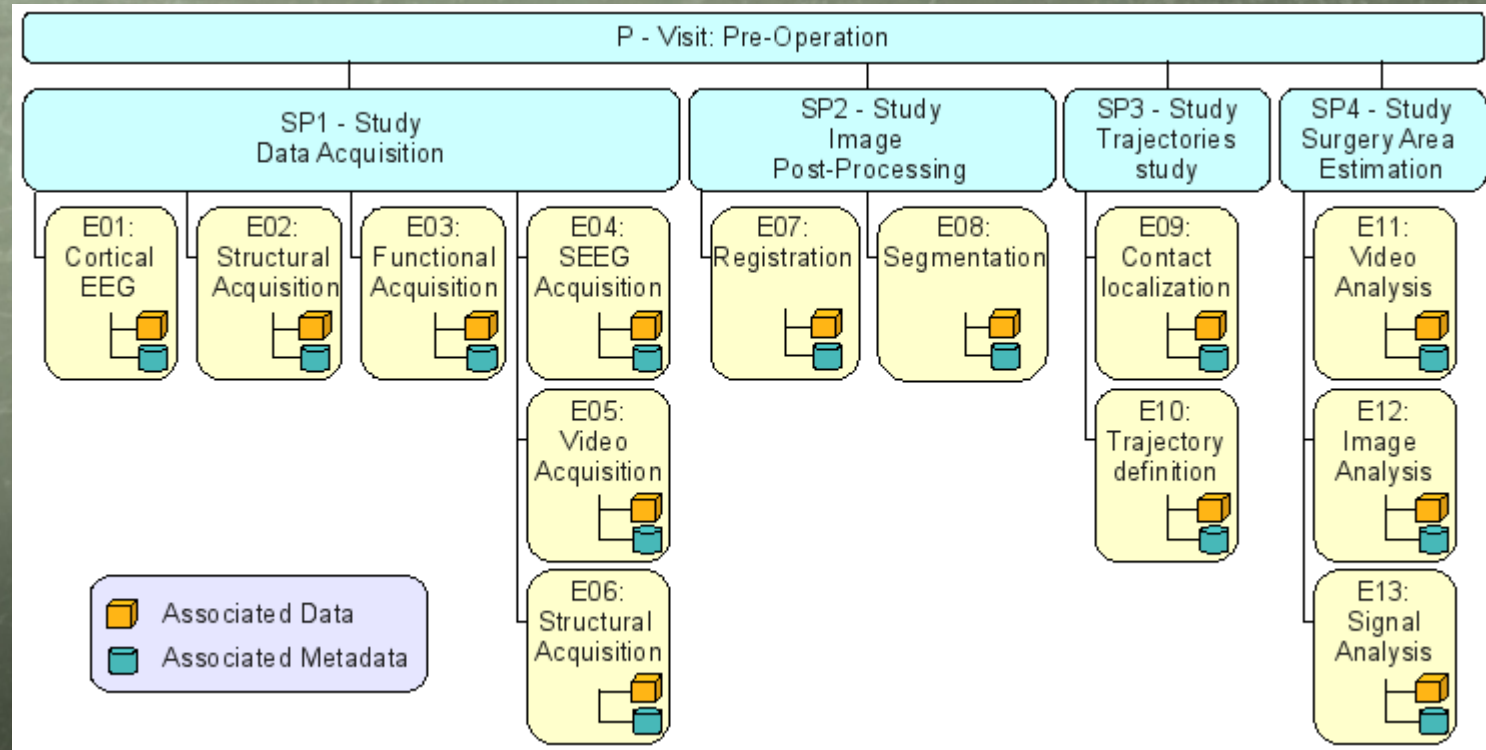
Process:
structured sequence of events

Event:
single step of the process

Conditional sub-processes

Detailed logs

Application Specific Taxonomic Structure



Specific configurations depending on different applications
Relationships between data and actions

Visits

Utente: **admin**
» Logout

Biolab Home List ▾

Processes management

Search parameters

State ▾

Nome Cognome

#	Type	State	Name	Surname	Data di nascita	Sex
11	Post-Operation	Running	ANDREA	BIANCO	23/06/1975	M
16	Pre-Operation	Running	BARBARA	BIALE	05/03/1960	F
19	Post-Operation	Running	CAVIGLIA	LAURA	01/01/2001	F

Actions:

[New Visit](#)

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Subjects

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» Logout

Biolab | Home | List ▾

Subject Administration Panel

Search Parameters

First Name Last Name

Search in Anagrafica All Subjects

Family Name	First Name	Sex	Active Vst	History	Details
LAURA	CAVIGLIA	F	Post-Operation	View	View
BIANCO	ANDREA	M	Post-Operation	View	View
BIALE	BARBARA	F	Pre-Operation	View	View

Actions:

[New Subject](#)

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Studies

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Biolab Home | List ▾

Studies in Pre-Operation

Subject: BARBARA BIALE
 Date of birth: 05/03/1960

Processes

Studies

#	Type	State	Location	
<input checked="" type="radio"/>	Data-Acquisition	Running	S.Martino	Close

Events

#	Type	Date and Time ↕	State
<input type="radio"/>	Start Process	18/12/2008 19:51	EEND0
<input type="radio"/>	MRI Acquisition	18/12/2008 19:52	EEND0
<input checked="" type="radio"/>	MRI Acquisition	26/05/2009 12:22	EEND0
<input type="radio"/>	MRI Acquisition	26/05/2009 14:46	EEND0
<input type="radio"/>	MRI Acquisition	26/05/2009 19:39	EEND0

Subject Data

#	Type	Uri	Description		
6	MRI	/repository/img/IM-0003-0010.dcm	MRI	info	Delete
27	Pippo	/opt/repo/temp/VasiSu3D.nii	Pippo	info	Delete
28	Pippo	/opt/repo/temp/MNI152_T1.nii	Pippo	info	Delete
29	ESAC001	/opt/repo/temp/ctpost.nii	ESAC001	info	Delete

Actions:

[New Visit](#)
[New Study](#)

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History

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[» Logout](#)

Biolab [Home](#) | [List](#) ▾

Visits

Subject: ANDREA BIANCO
Date of birth: 23/06/1975

Processes

Visits

#	Type	State	Location	
<input type="radio"/>	Pre-Operation	Finished Success	S.Martino	Close
<input checked="" type="radio"/>	Focus-Localization	Finished Success	Niguarda	Close
<input type="radio"/>	Post-Operation	Running	S.Martino	Close

Subject Data

#	Type	Uri	Description		
5	CT	/repository/img/IM-0006-0008.dcm	CT	info	Delete
31	ESAC000	/opt/repo/temp/MNI152_T1.nii	ESAC000	info	Delete
37	XMLElect	NO_URI	XMLElect	info	Delete
38	EEG	/opt/repo/temp/N 1-2 5mA DenisD.EDF	EEG	info	Delete

Actions:

- [New Visit](#)
- [New Study](#)

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Collaborative environment in support to epilepsy surgery

Partner: Niguarda Hospital - Milan

Drug resistant epilepsy

Ablation of the epileptogenic zone

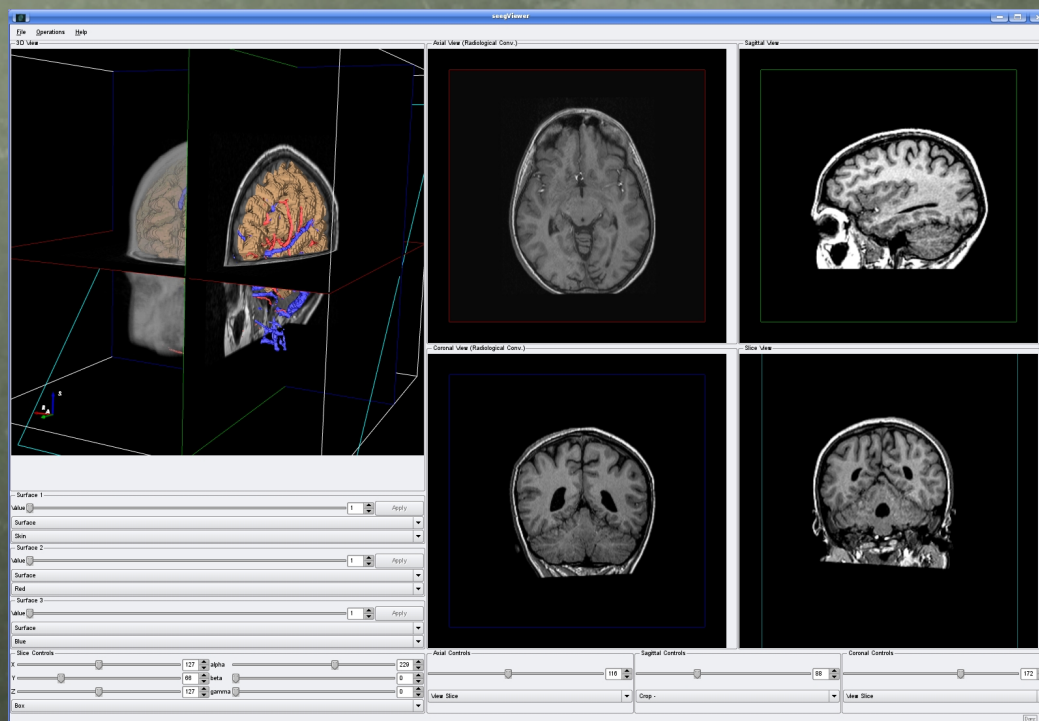
Surgical planning

Collaborative environment

Multimodal imaging
Visualization tools

Registration and
segmentation methods

Time series analyses



Collaborative environment in support to epilepsy surgery

Electrodes implantation for SEEG acquisition

Implant planning for trajectories

Mapping of positions and signals on the reference space

Analysis of SEEG traces

Definition of surgical targets

Surgical planning

Retrospective studies with a large number of cases

Mapping on atlases

Model of epileptic seizures



Collaborative environment in support to epilepsy surgery

Requirements

Distributed data

Imaging & signals

Extensible repository

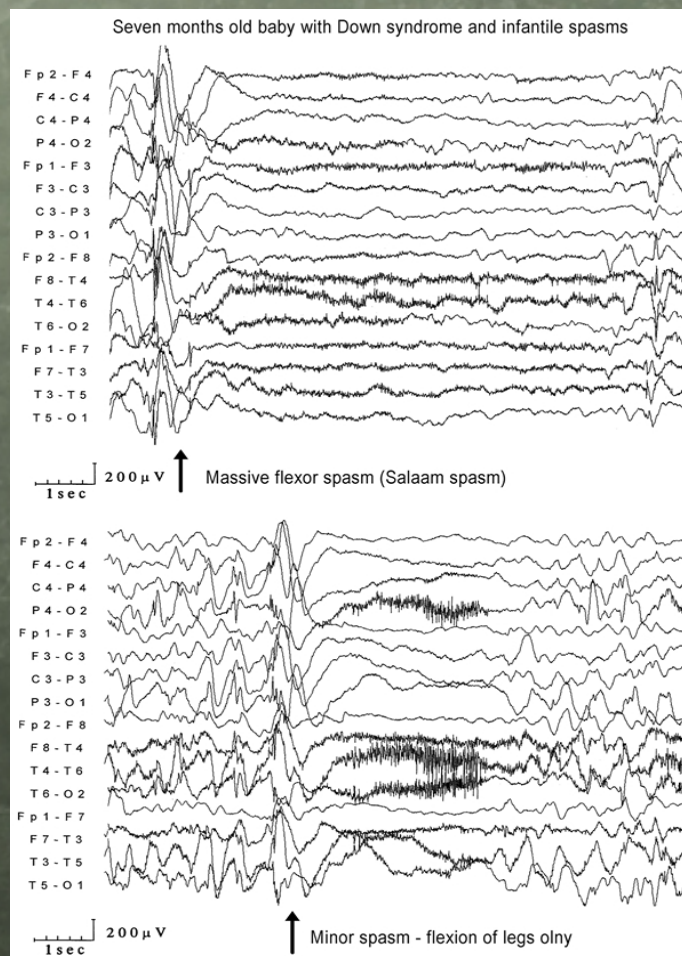
Safe web access

Multimodal correlation

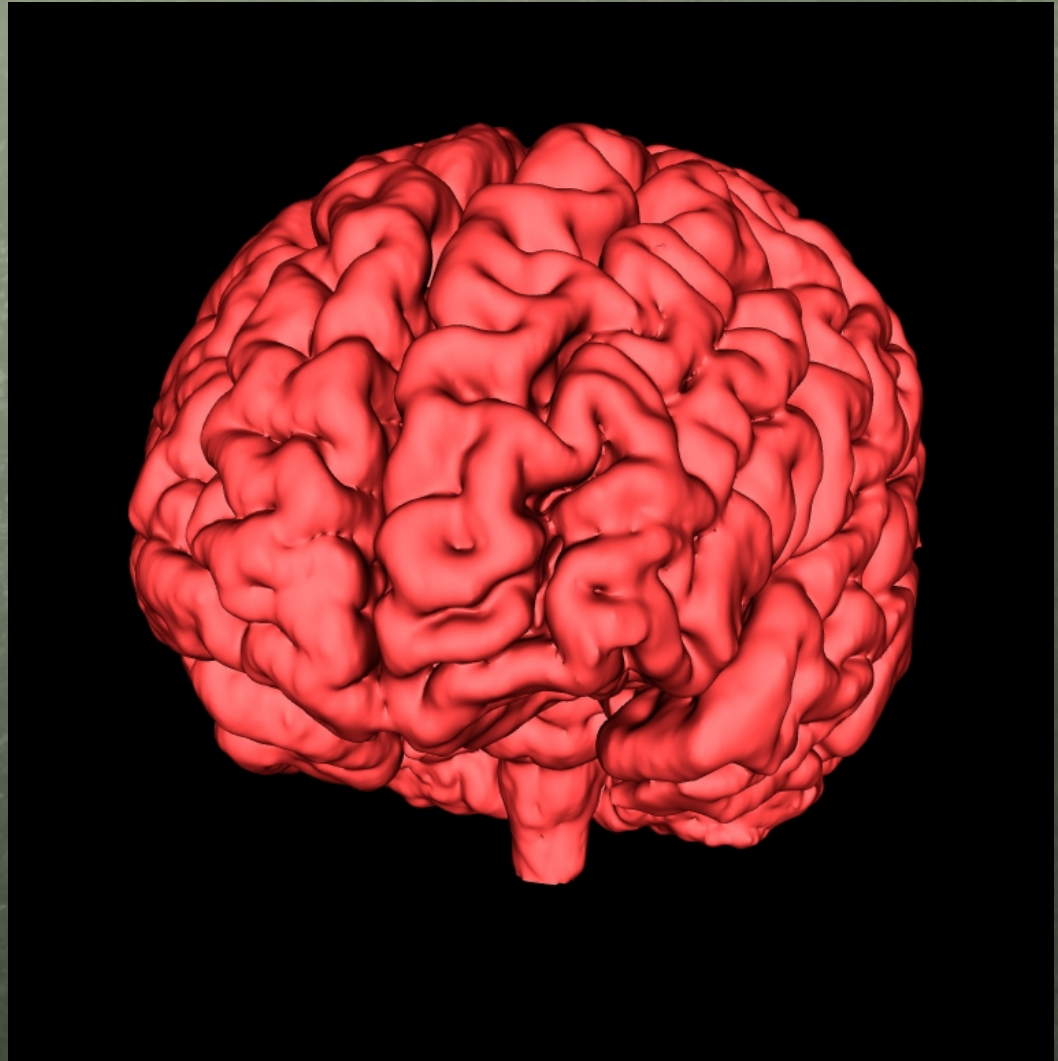
Interactive/Remote
visualization

Computational requests

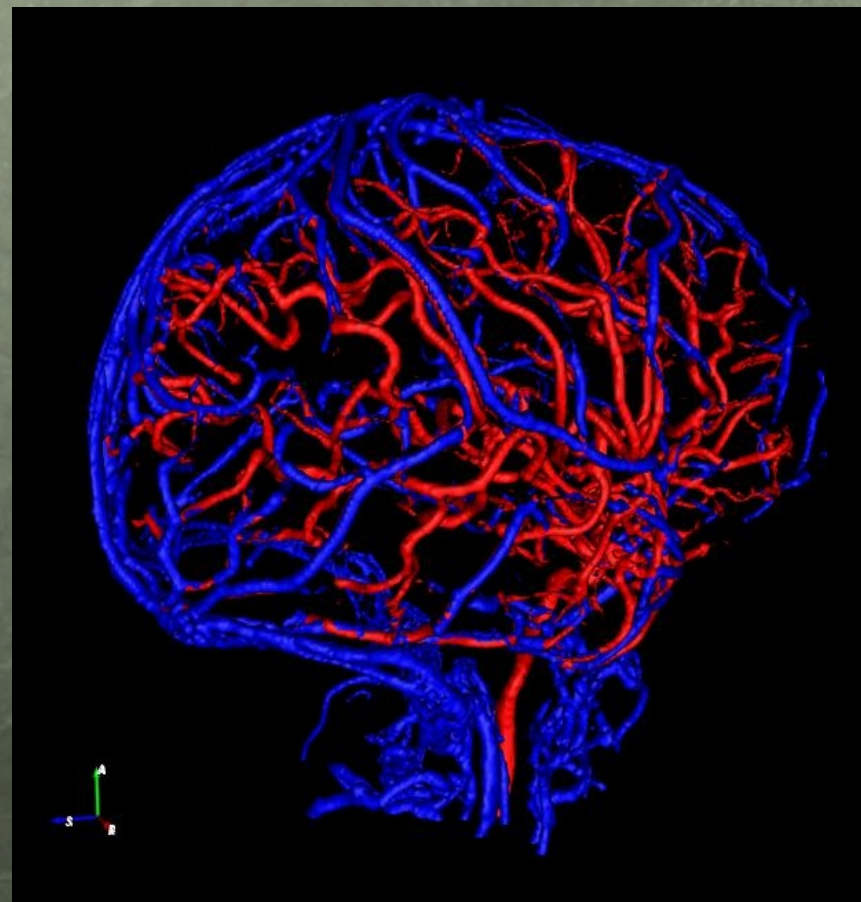
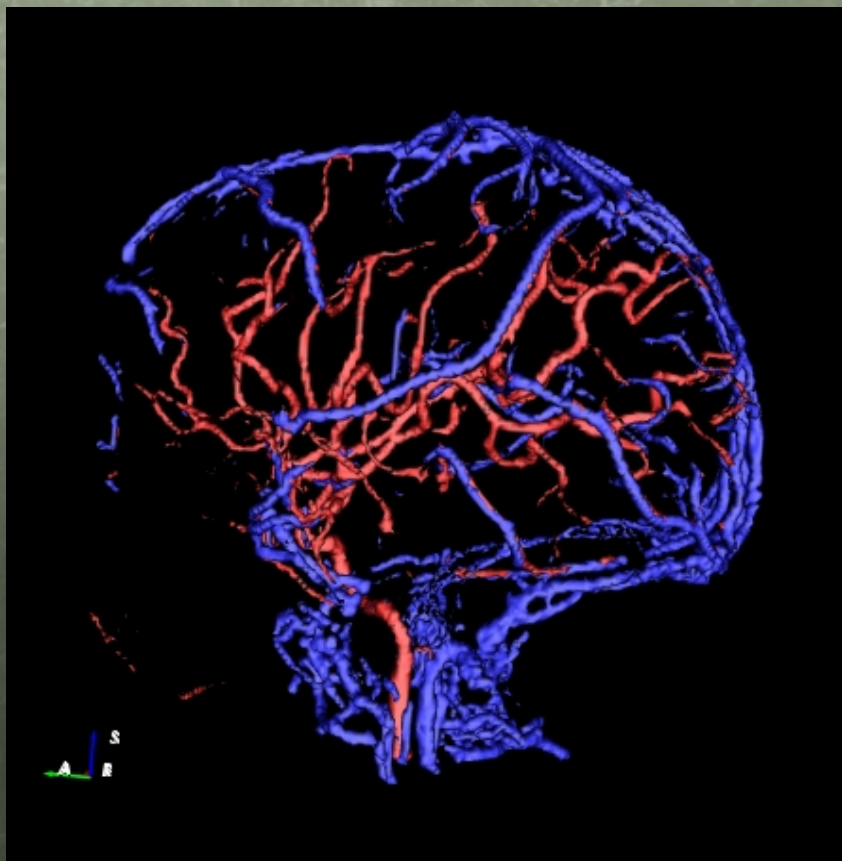
Metadata management



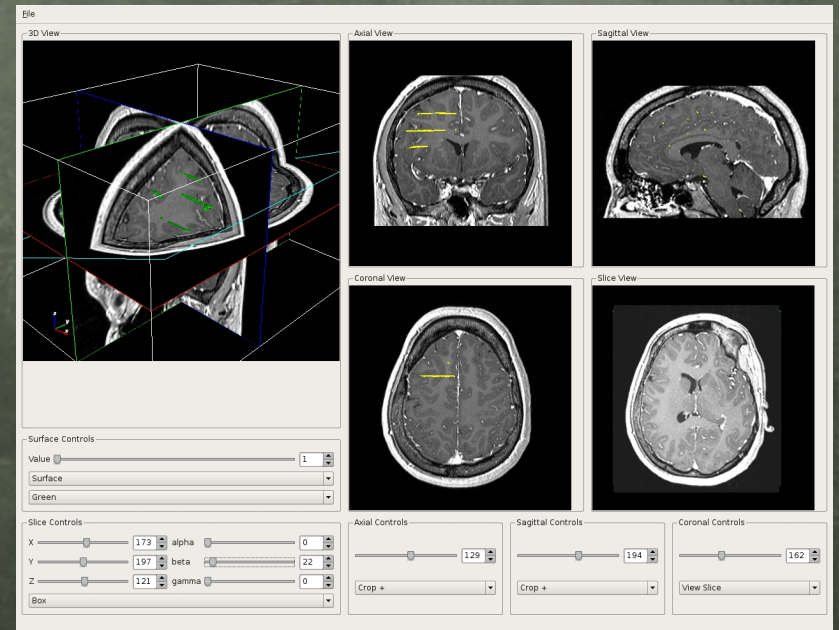
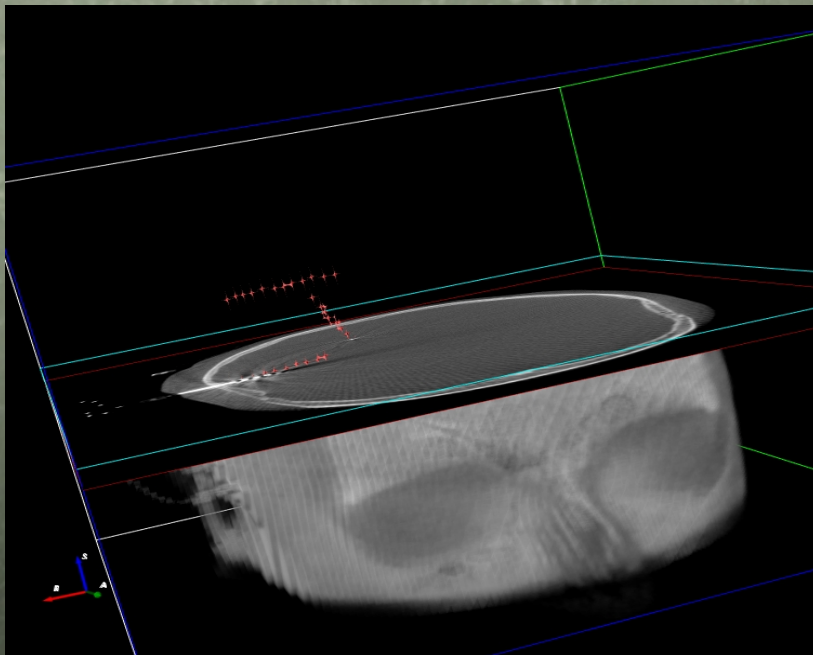
Brain



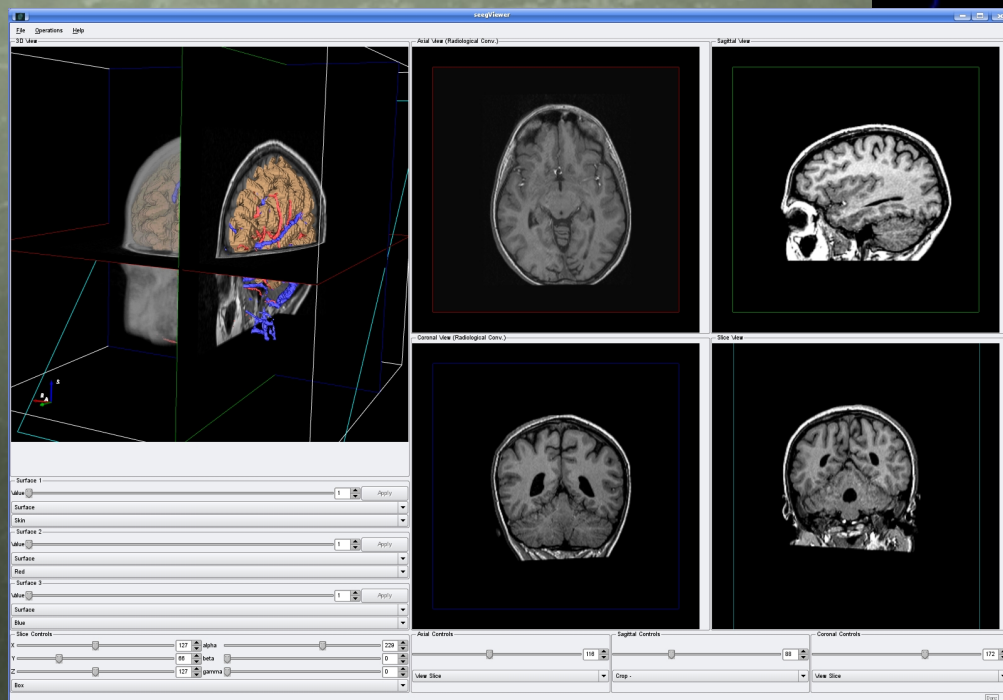
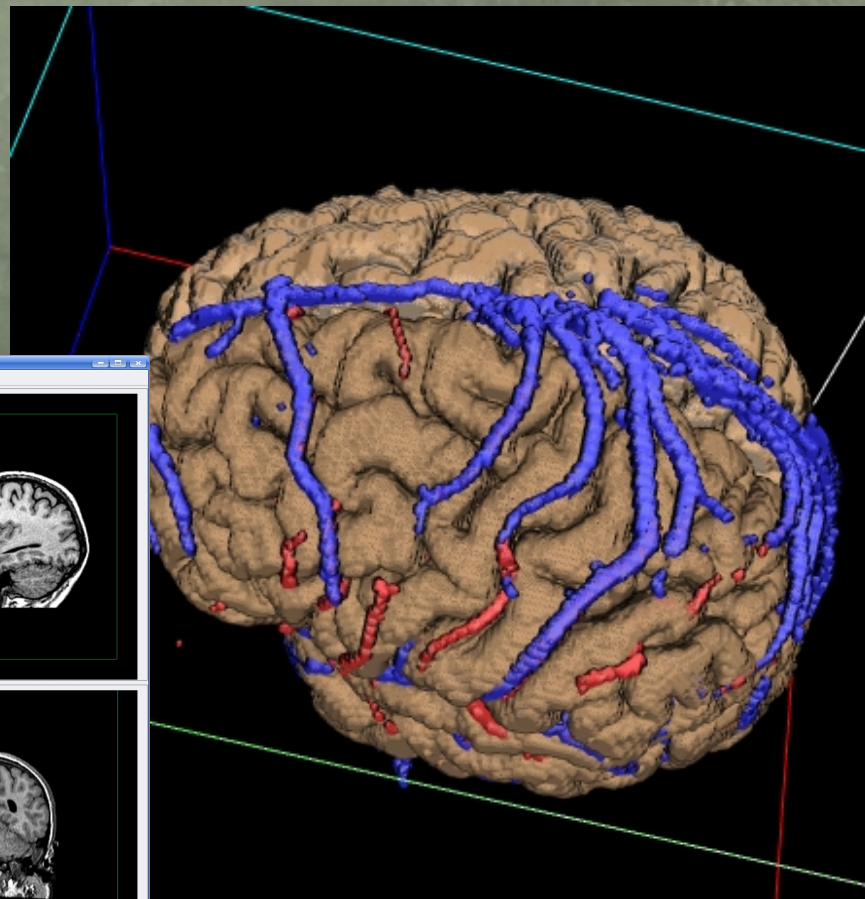
Vessels



Electrodes



Segmentation
Registration
Integration
Mapping



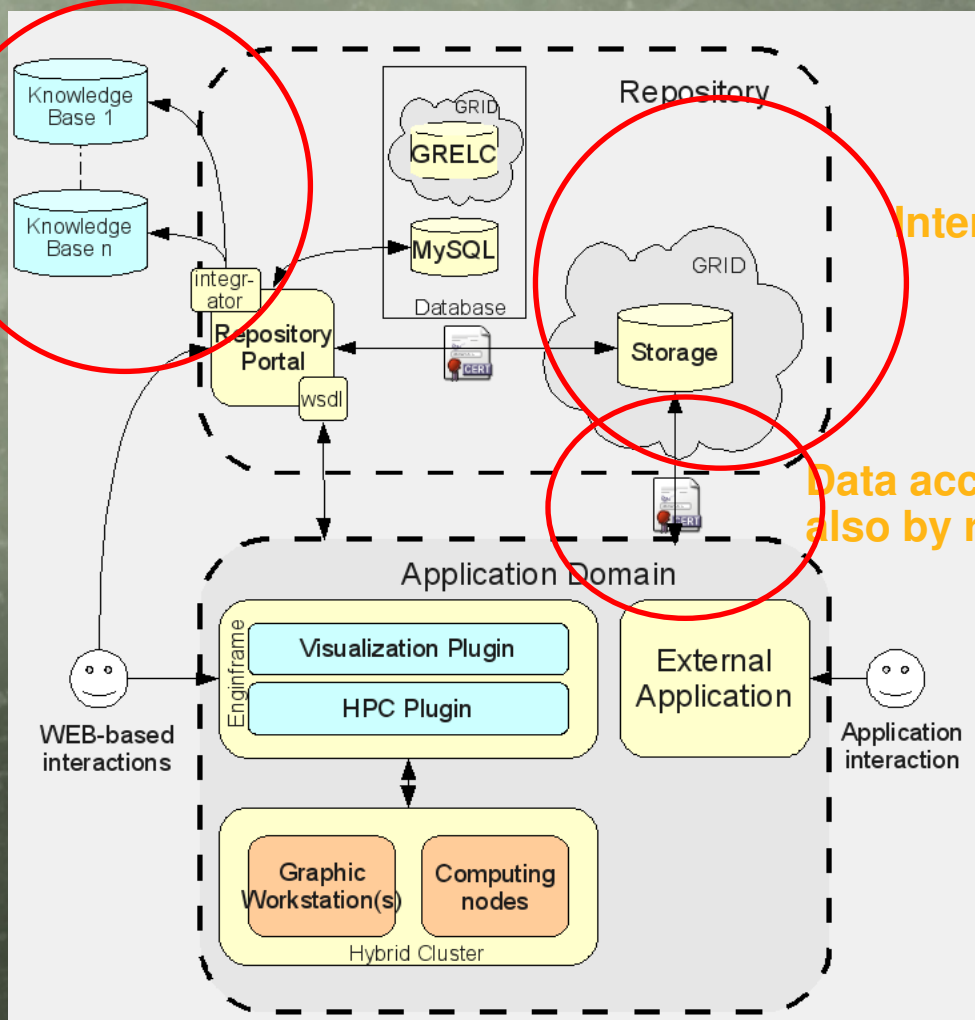
Details in:

Corradi et al. HealthGrid 2009

Thanks

XTENS architecture

Semantic integration
with external sources



Interface to PACS/RIS

Data access protected
also by robot certificates