



a n e u r i s t

Integrated biomedical informatics for the management of cerebral aneurysms

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Outline

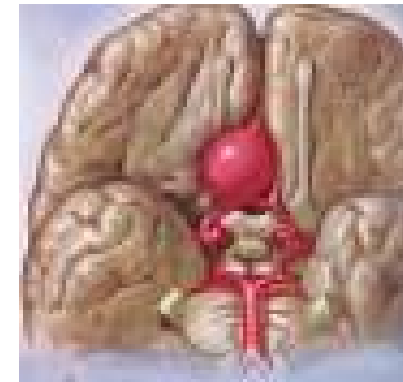
- The @neurIST Project – Goals and Objectives
- @neurIST SOA & Middleware
- Compute Services
- Data Services
- Conclusion





Integrated Biomedical Informatics for the Management of Cerebral Aneurysms

- Integrated Project, FP6, European Commission
- Project duration: 2006-2009 (48 months)
- 33 Partners
- Budget: ~17,5 MEuro



Objectives:

- Development of a **generic Grid infrastructure** for the **management and processing of heterogeneous data** associated with the diagnosis and treatment of cerebral aneurysms and subarachnoid haemorrhage.
- Transform the management of cerebral aneurysm by providing new insight, **personalised risk assessment** and methods for the **design of improved medical devices** and treatment protocols.

Personalised risk assessment could reduce unnecessary treatment by 50%, with concomitant savings estimated in the order of several billions of Euros per year.



@neurIST Consortium (www.aneurist.org)

ANSYS Europe Ltd., UK

Advanced Simulation and Design GmbH, DE

Cancer Research UK

Ecole Polytechnique Federale de Lausanne, CH

Erasmus University Medical Centre, Rotterdam, NL

Fraunhofer Gesellschaft (SCAI), DE

Grid Systems S.A., ES

IDAC Ltd., IE

IMIM (Inst. Municipal d'Assistencia Sanitaria), ES

Infermed Ltd., UK

INSERM,FR

Hospital "Clinic I Provincial de" Barcelona, ES

KTH (Kungliga Technische Hoegskolan), SE

Medical U. Pecs, HU

Neuroangiografia Terepeutica S.L, ES

NEC Europe Ltd., DE

Philips Medical Systems, NL

Supercomputing Solutions S.R.L., IT

The Thrombosis Research Institute, UK

U. Clinic Freiburg, DE

U. Geneva (and U. Hospital), CH

U. Luton, UK

U. Medical Centre, Utrecht, NL

U. Oxford, UK

U. Pompeu Fabra, ES (Coordinator)

U. Sheffield, UK

U. Vienna, Austria

William Cook Europe APS, Denmark

Tohoku U., JP

George Mason, US

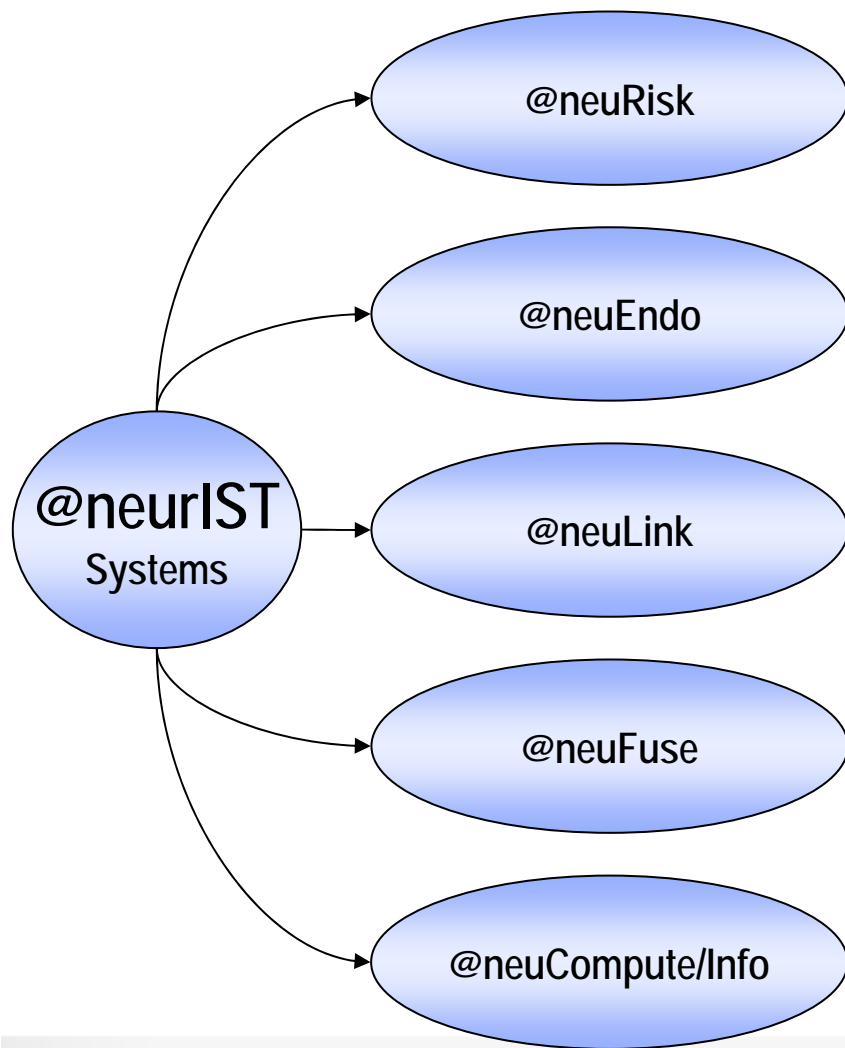
Mayo Clinic, US

Centre for Biomolecular Discovery,

U. Wellington, NZ



Integrative Application Suites



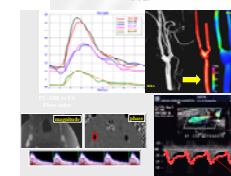
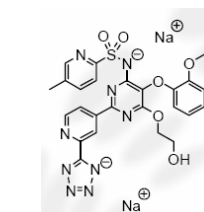
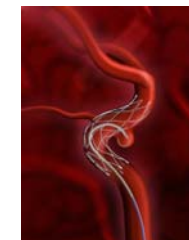
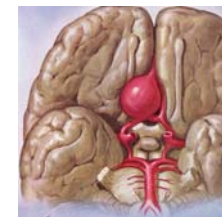
Improve **decision making** processes in the management of **unruptured aneurysms** by providing a score that integrates all the available information for **identifying at-risk patients** and reducing current over treatment

Support **computational design** processes towards a **next generation of smart flow-correcting implants** to treat **ruptured aneurysms** and reduce current treatment costs, side effects and recurrence.

Support the **knowledge discovery** for **linking genetics** to disease, vasospasm and blood clotting after cerebral hemorrhage

Support the **integration of modeling, simulation and visualization** of multimodal data

Support integration of data and computing resources.

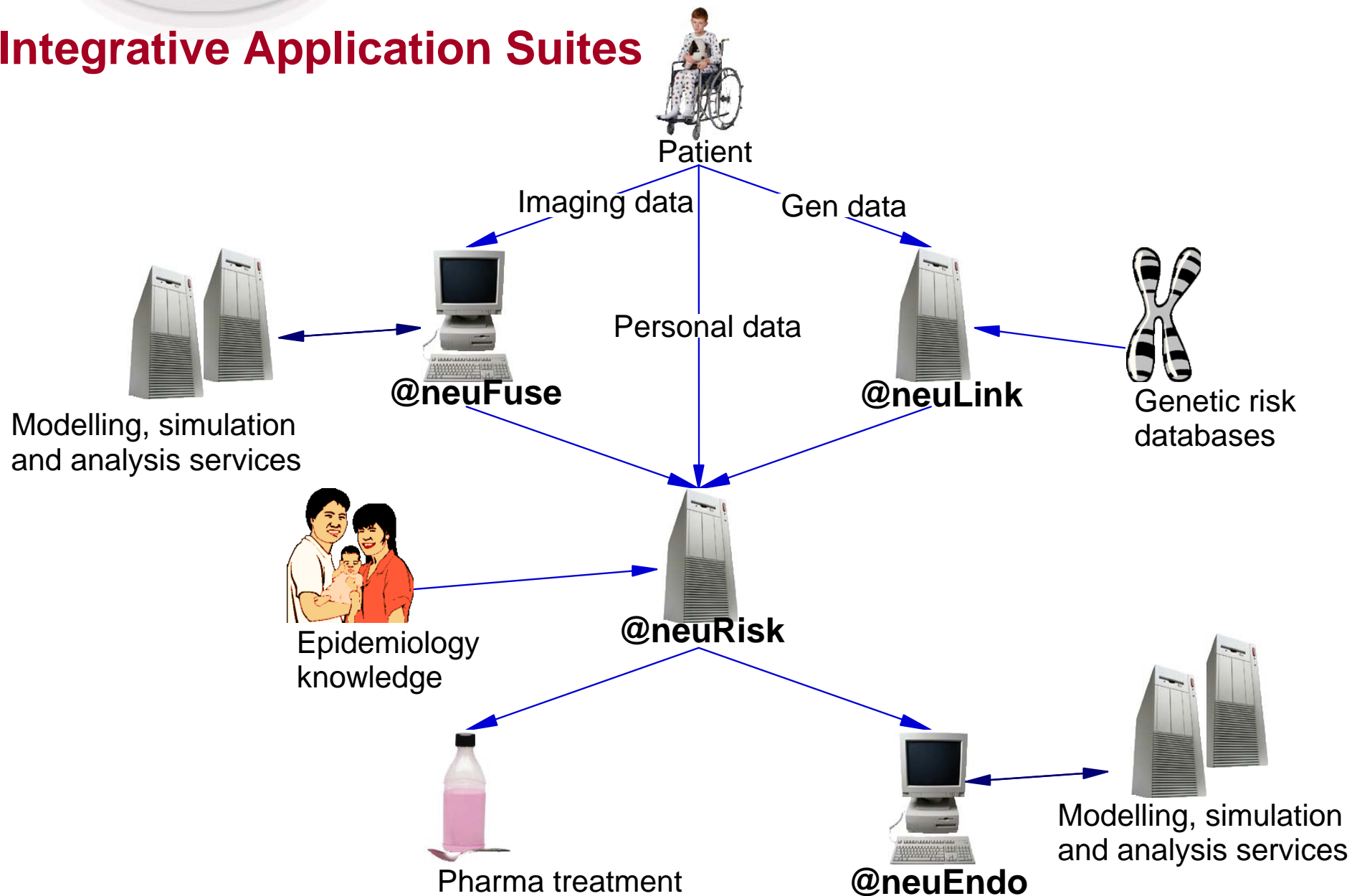


Support Tools

Enabling IT

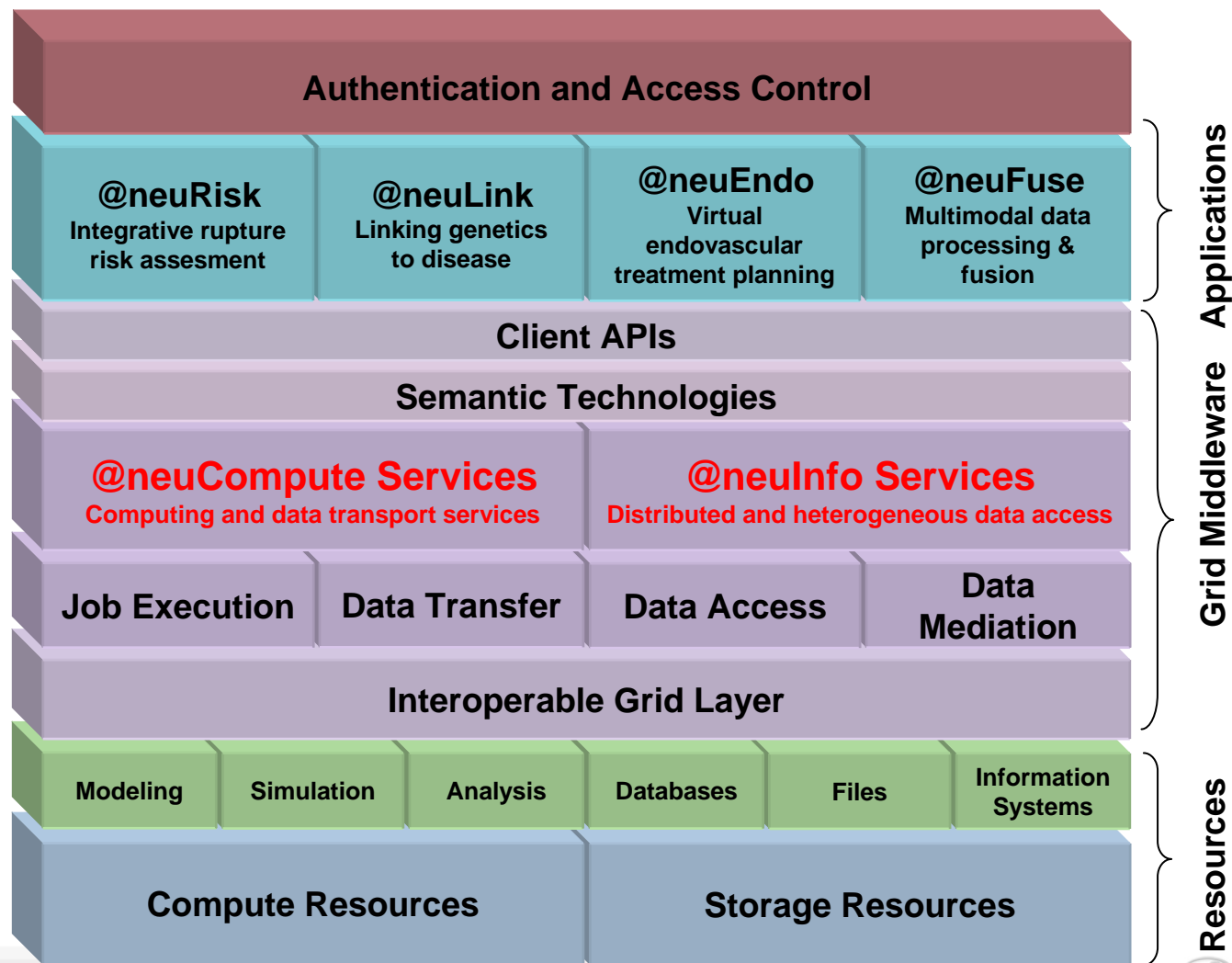


Integrative Application Suites





@neurIST Grid Infrastructure – High-Level View



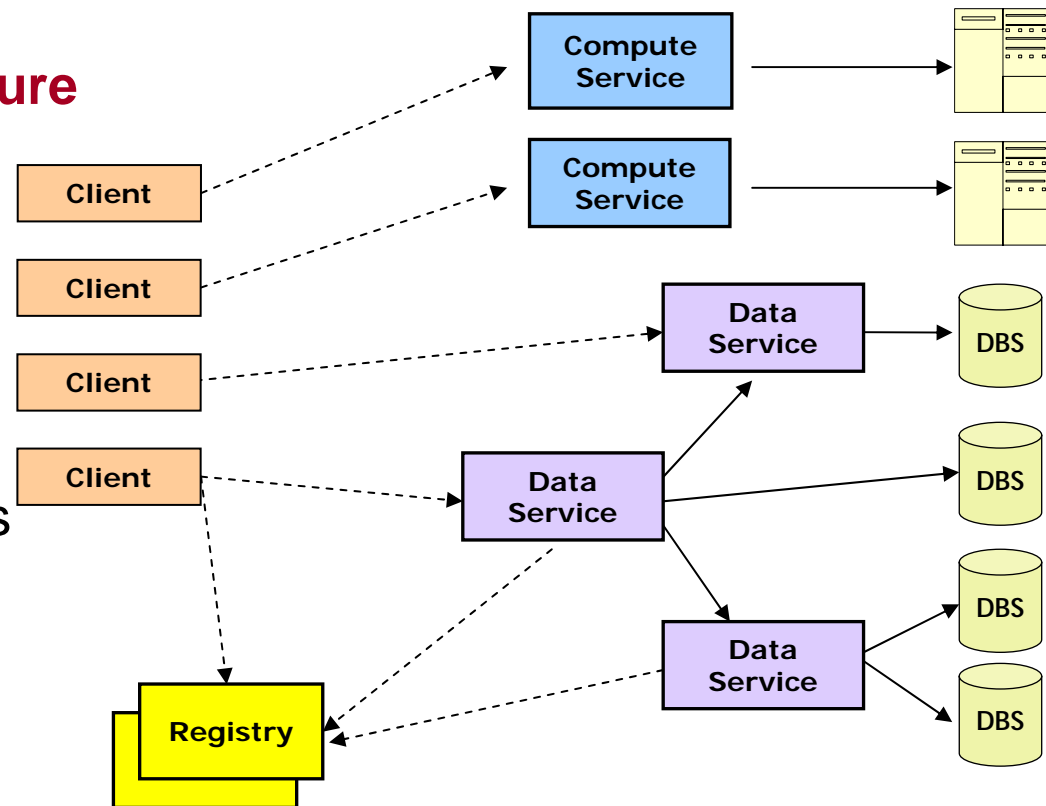


Service Oriented Architecture

- Compute Services
- Data Services

Virtualization

- Generic service interfaces
- QoS support
- SLA negotiation

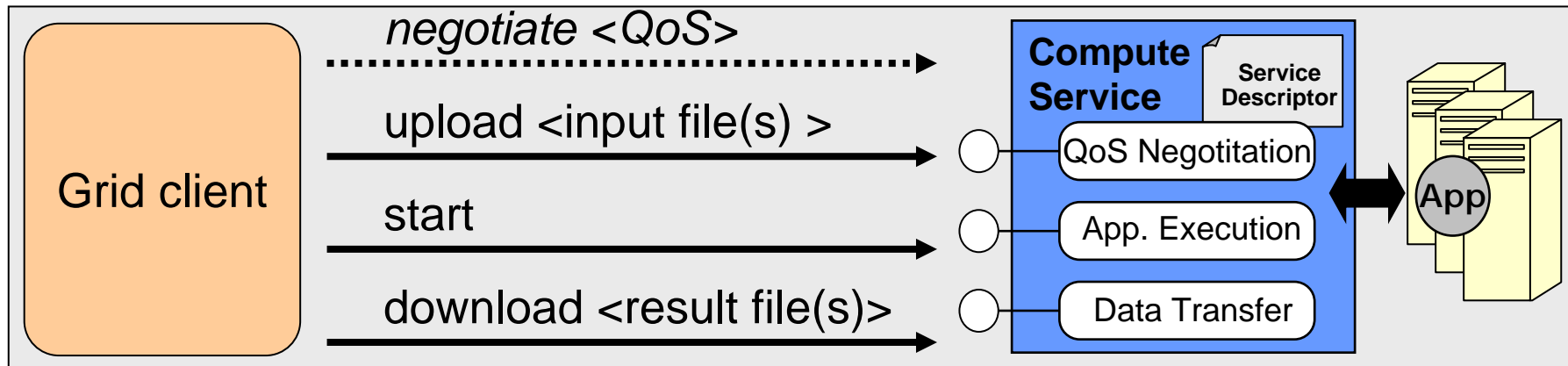


Technologies

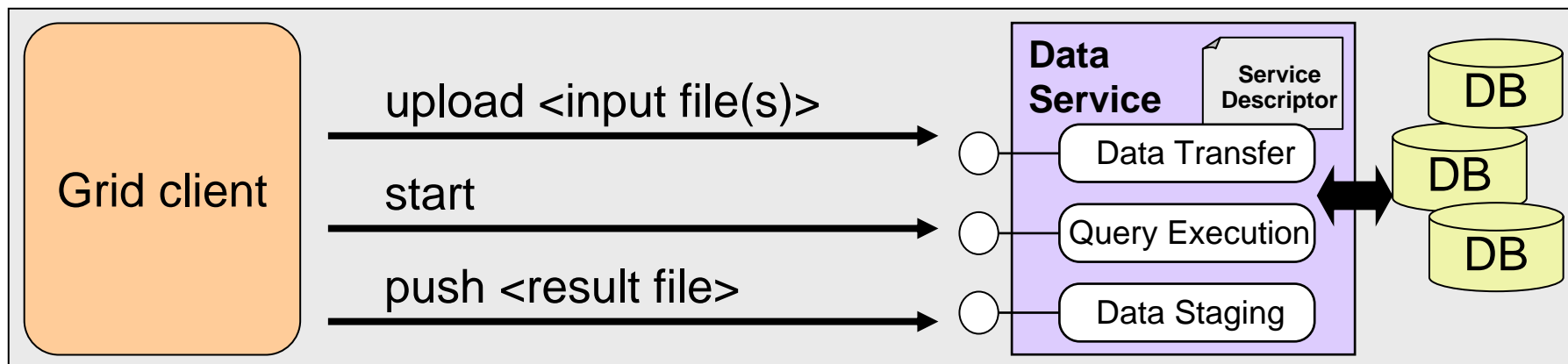
- Grid Middleware: GEMSS2, InnerGrid; VGE; Web Services
- Data Integration: OGSA-DAI – WS-DAI; DQP; SQL
- Semantics: OWL



@neuCompute Services



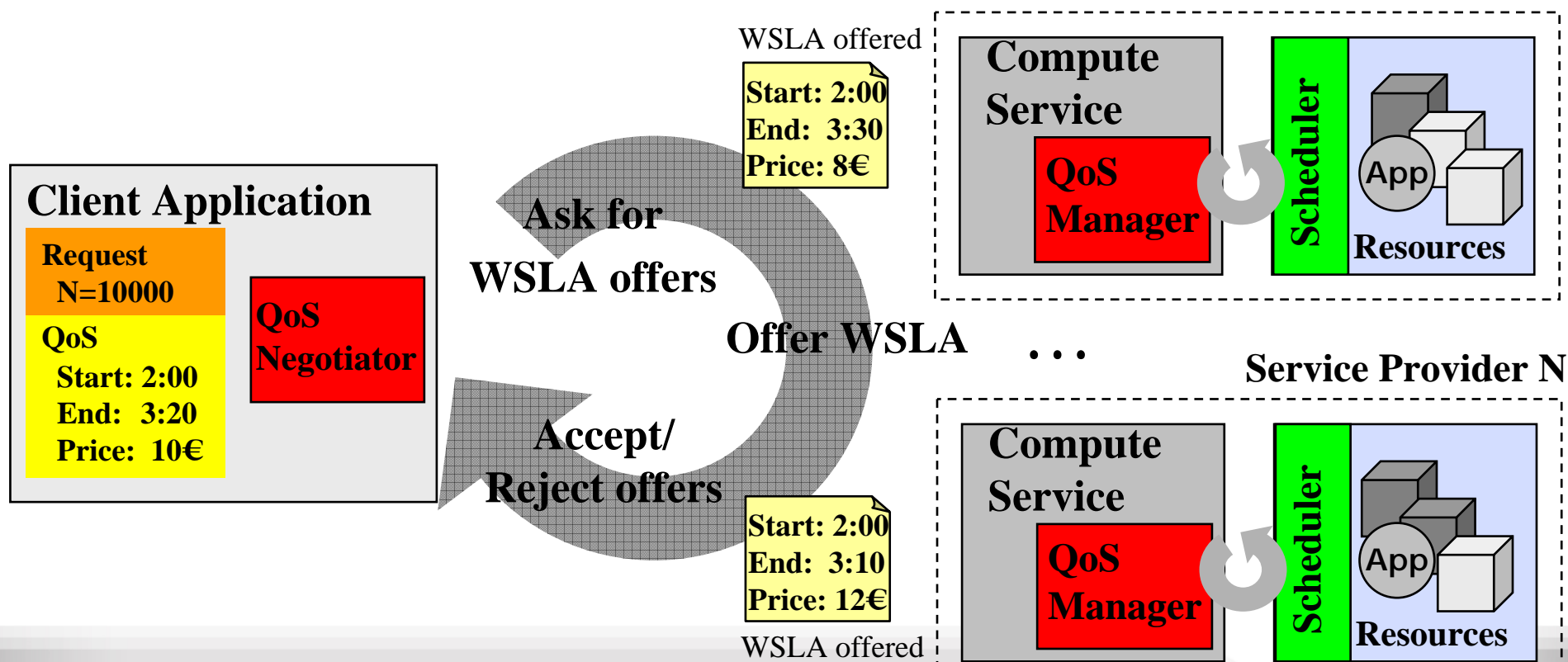
@neuInfo Services





SLA Negotiation and QoS

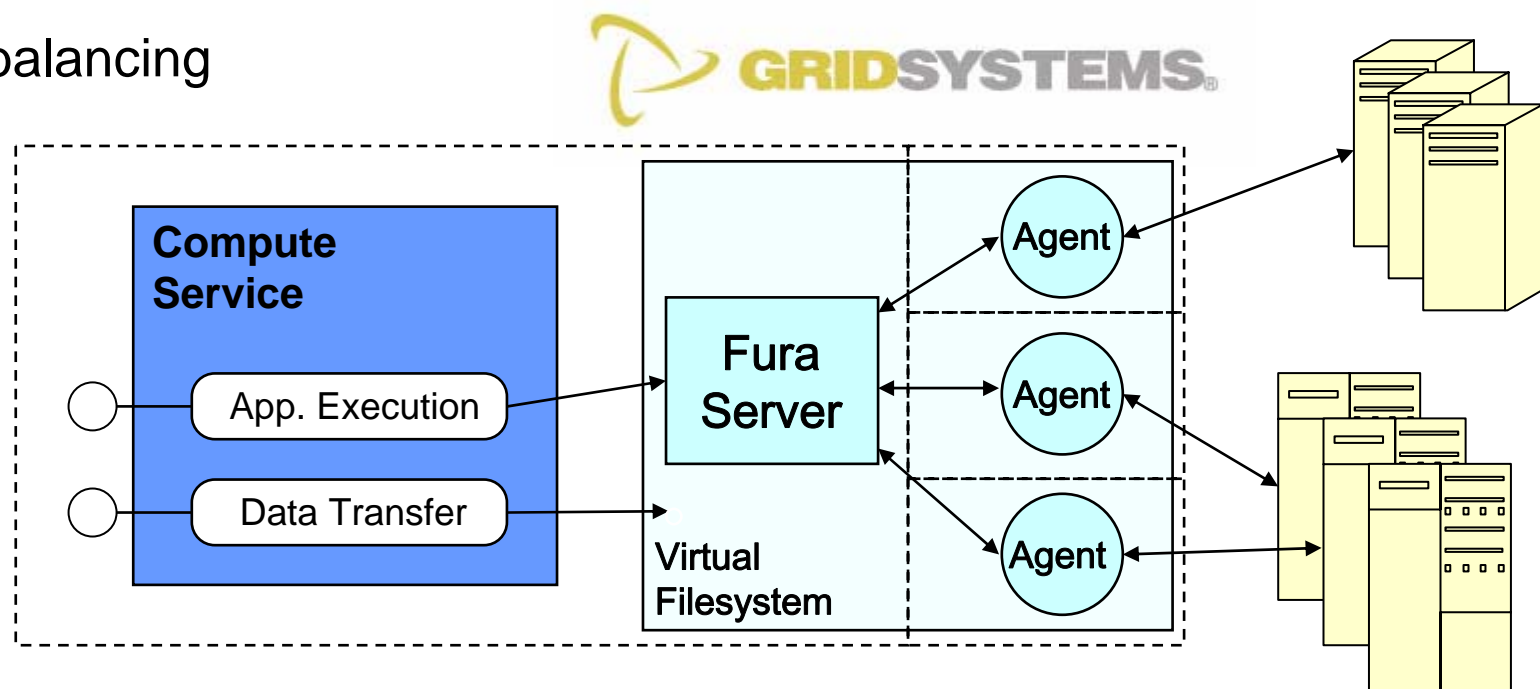
- Client-driven QoS negotiation with potential service providers
- Signed Service Level Agreement (WSLA) exchanged with winner
- QoS Negotiation: request/offer model, auction models, ...
- QoS Management: performance estimation, resource reservation, ...





Compute Service Scenario - Interaction with Fura

- Commercial Grid middleware developed by Grid Systems S.A.
- Intra-organizational Grid
- High-throughput computing
- Parameter studies
- Load balancing





@neurIST Data Integration Scenario

Approach

- Semantic Data Mediation
- Federation of Services
- CRIM, Ontology
- Security, Pseudonymization, ...

Hospital information systems

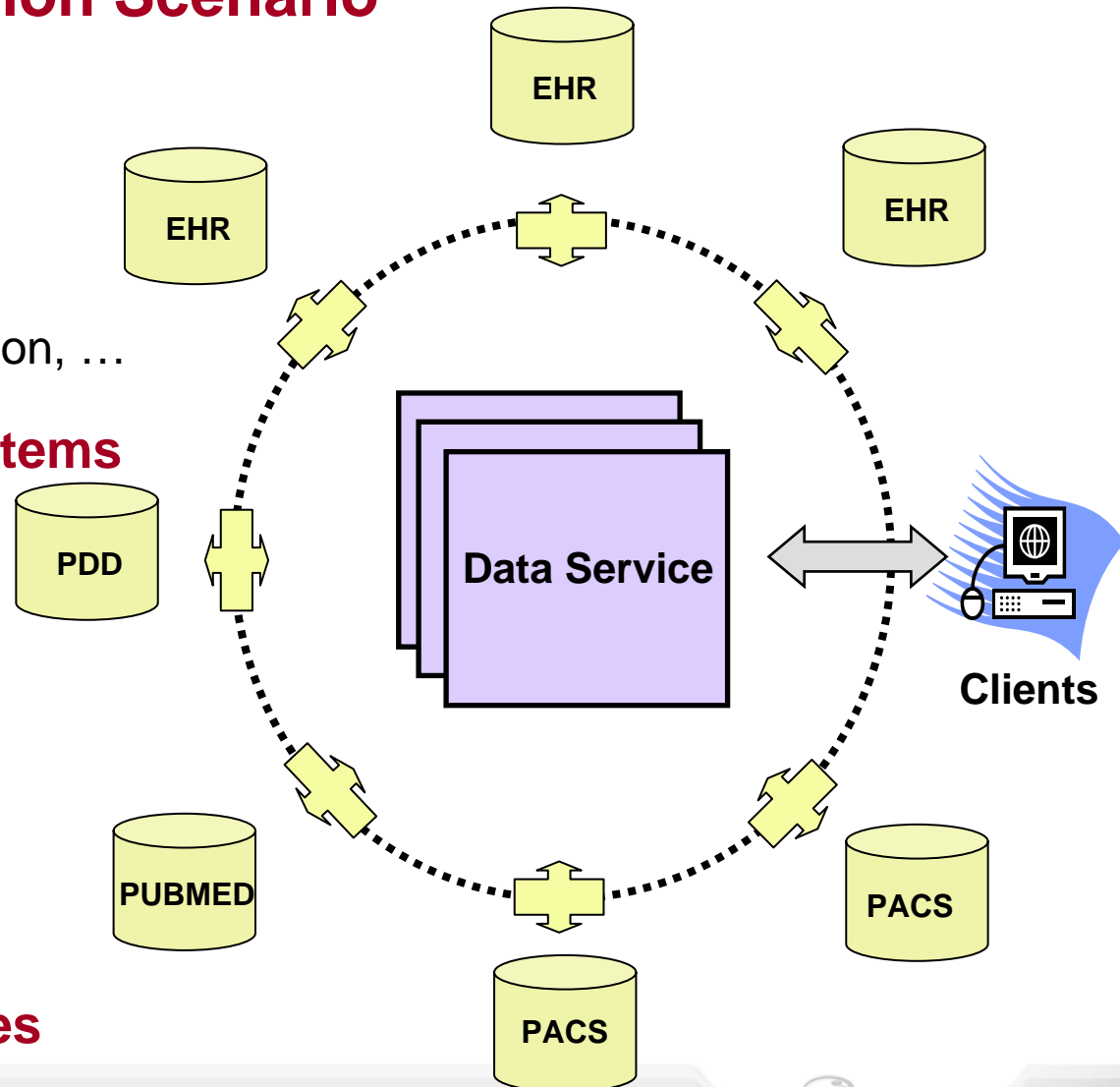
- Sheffield, Geneva, Rotterdam, ...
- EHR, PACS, ...

Public databases

- Genetic: EBI, NCBI
- Literature: Medline, etc.

Product design databases

- COTS stents, coils, etc.

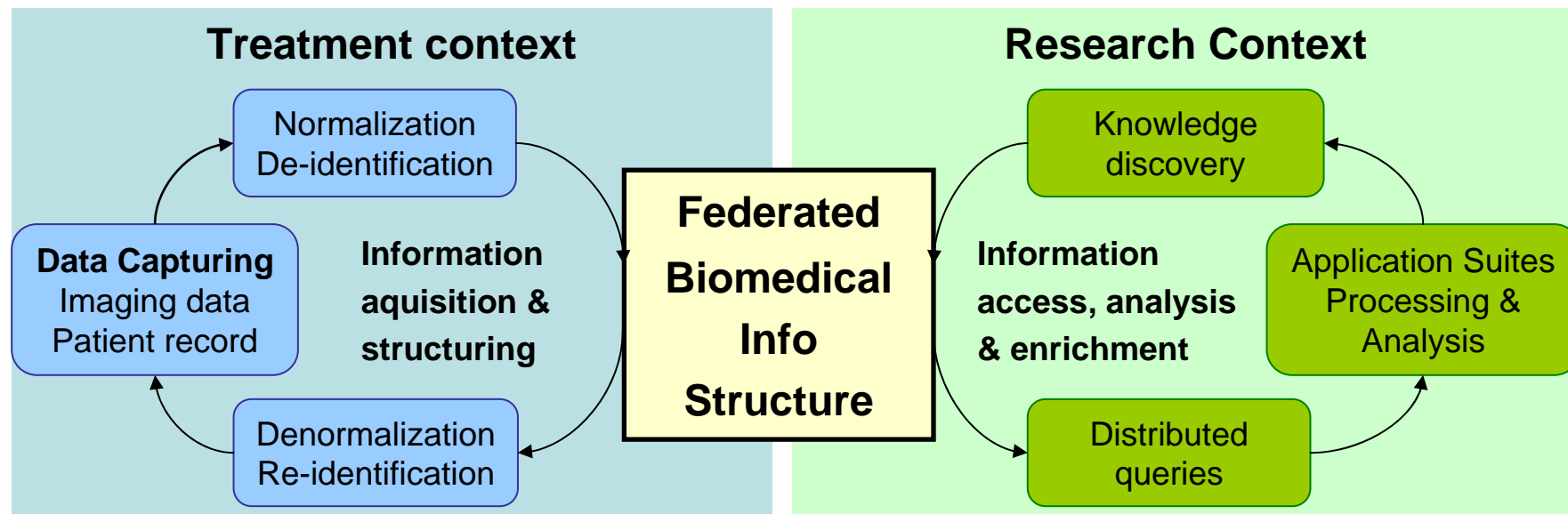




● Clinical Reference Information Model (CRIM)

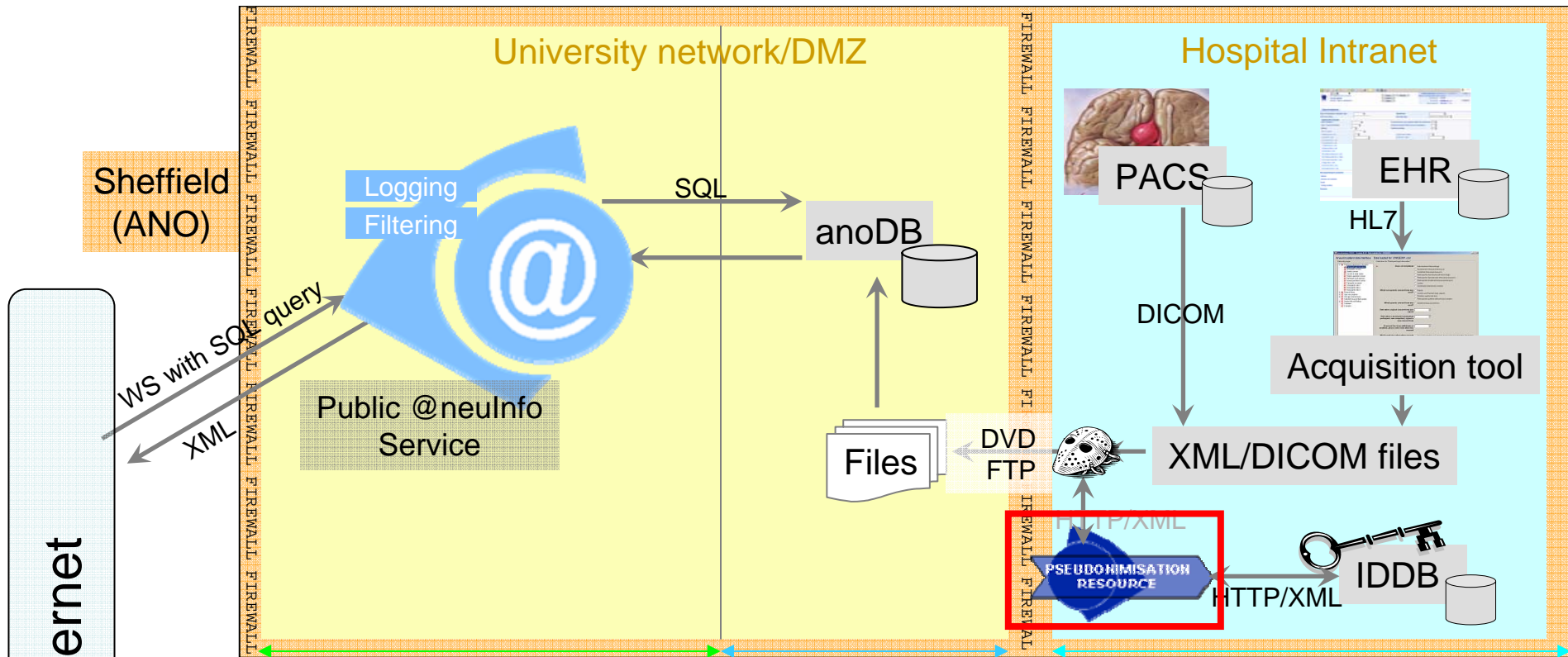
Defines all information to be captured for a patient

- clinical information (imaging, diagnostic and treatment data, ...)
- administrative information
- research results produced (indicators)

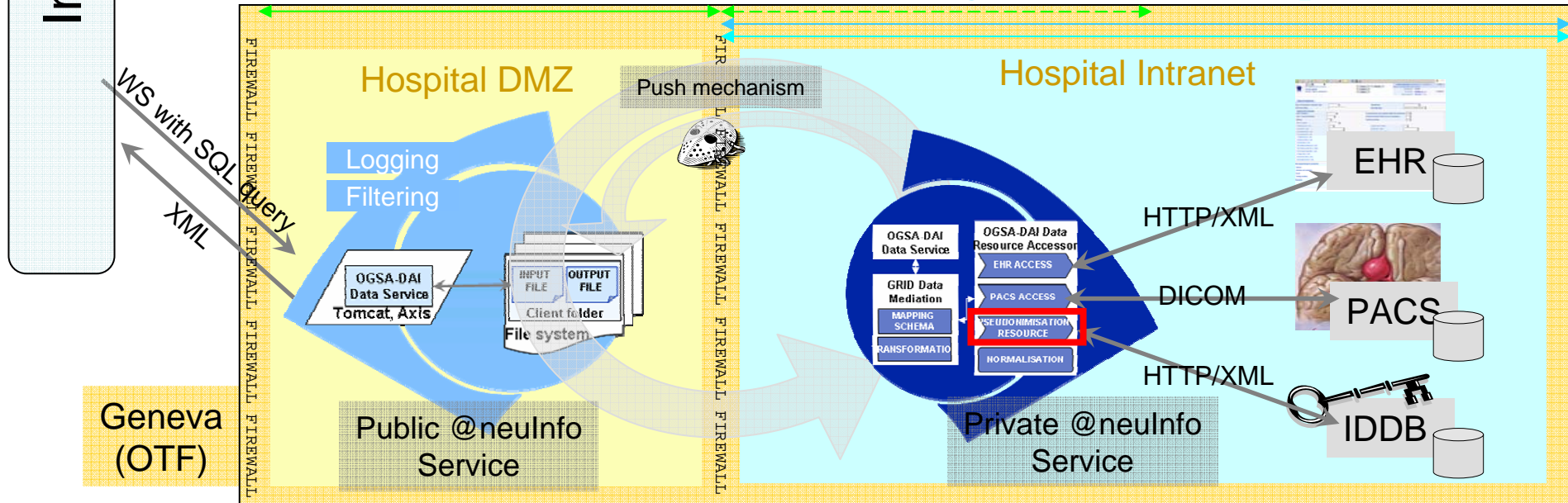


● Biomedical data infostructure

Two different architectures (see next slide)



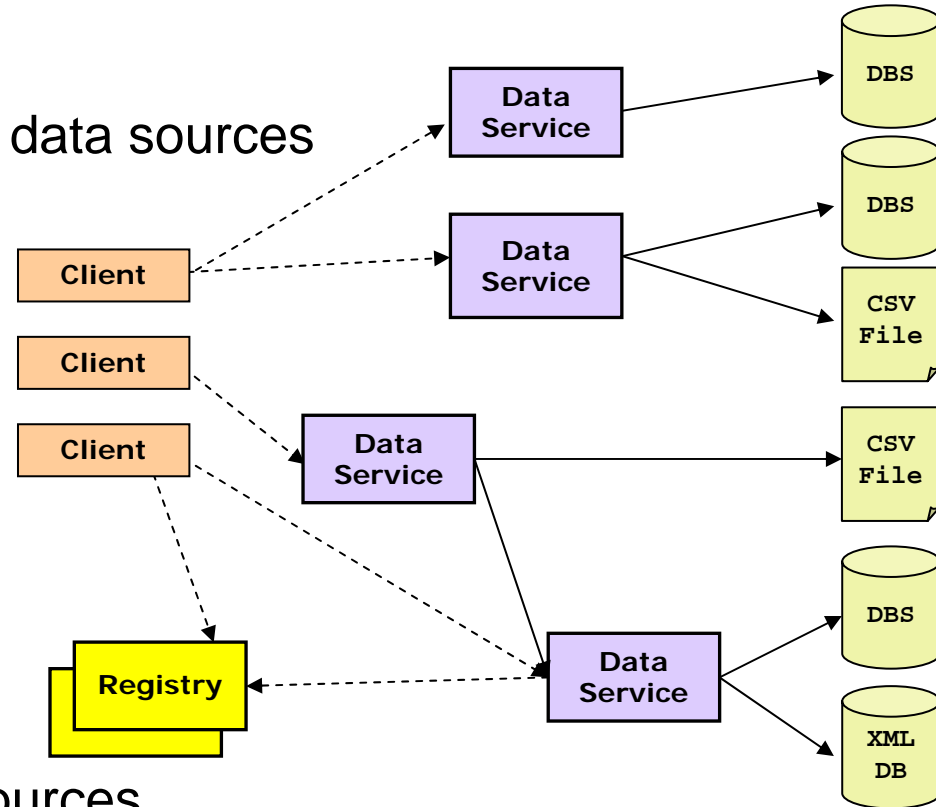
Data Access Data Storage Data Acquisition





@neulInfo Data Services

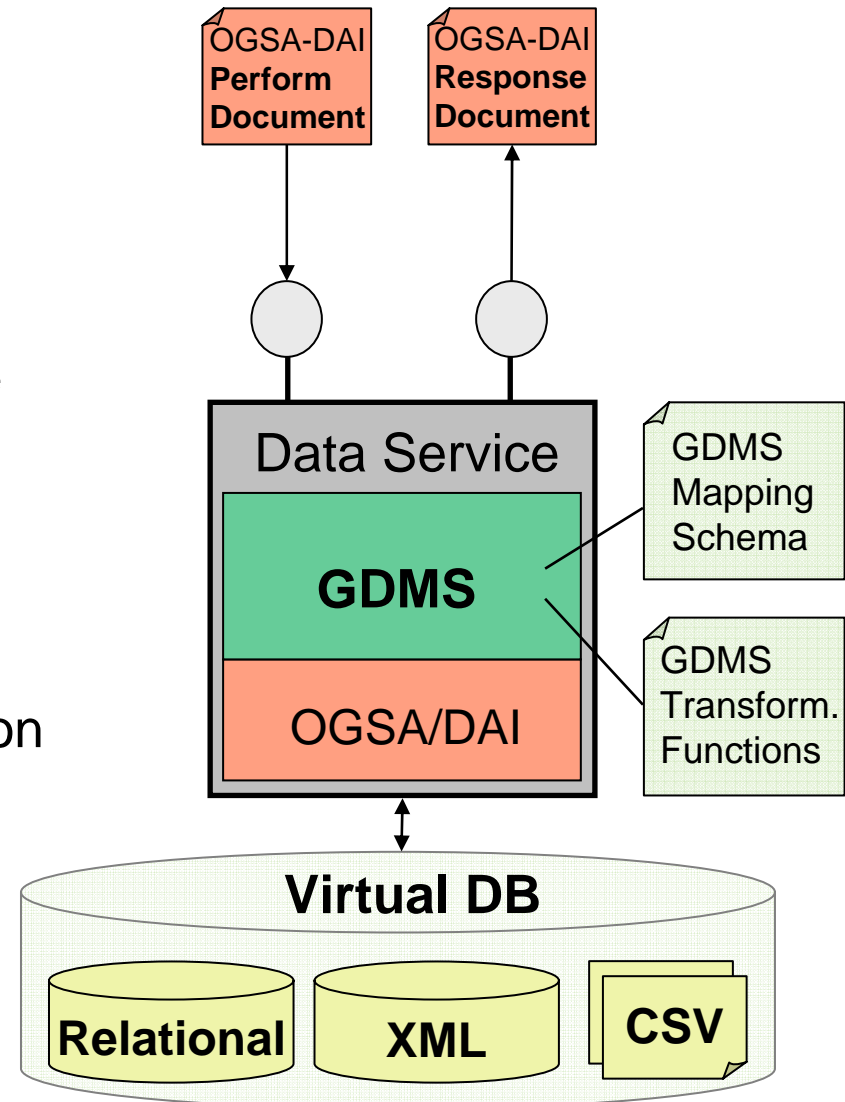
- **Virtualization** of heterogeneous data sources as services
- Same access mechanisms as compute services
- Different Variants
 - **Data Access Services**
access to single data source
 - **Data Mediation Services**
integration of multiple data sources
- Based on (Grid) standards
 - OGSA/DAI, OGSA/DQP
 - SQL, XML





Data Mediation Services

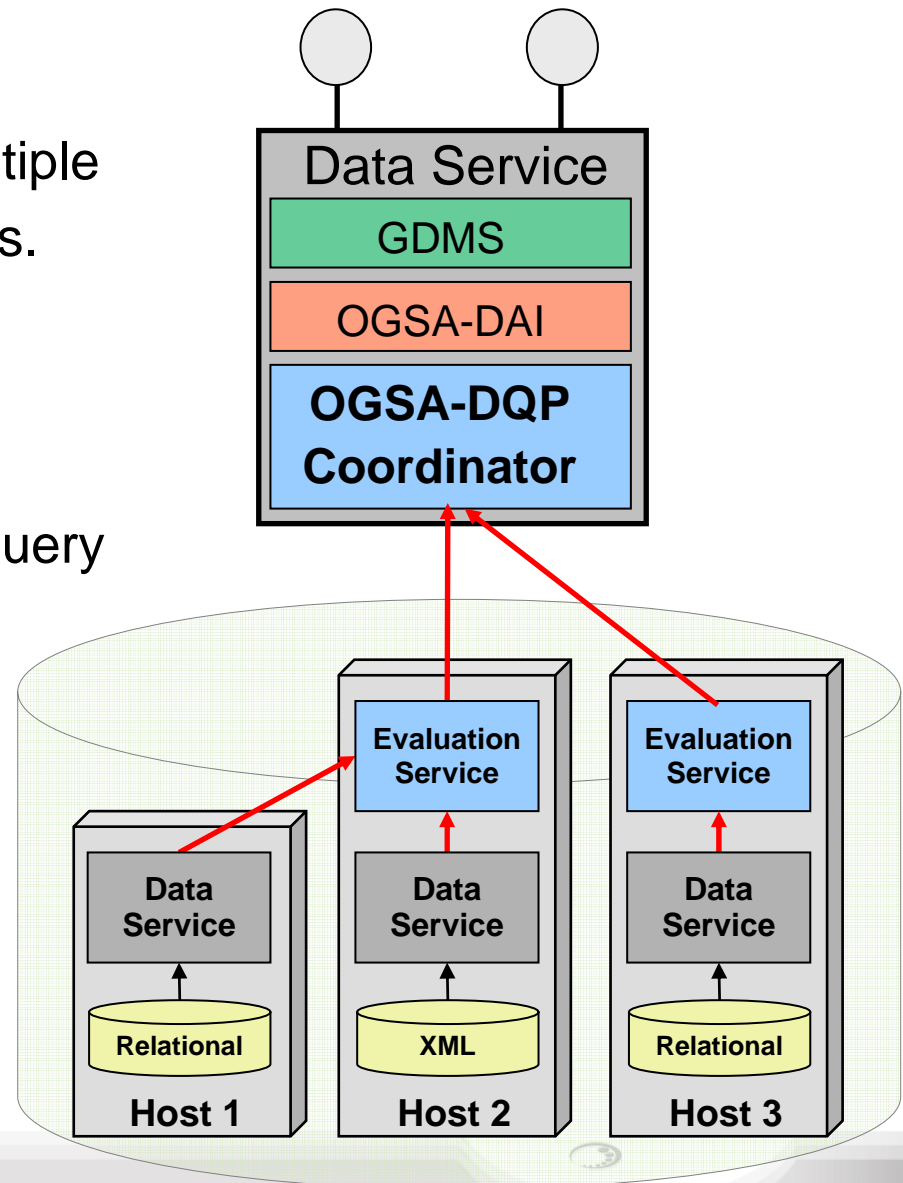
- **Transparent access to multiple data sources**
 - **Virtual global schema**
 - Data stays where it is; always live
 - Schema, language and interface transparency
- **GDMS Mapping Schema**
 - Global-as-View query reformulation
 - Different views of data
- **GDMS Transformation Functions**
 - On-the-fly data transformation via user-defined Java methods





Distributed Query Processing

- Optimize complex queries using multiple evaluation services on different hosts.
- based on **OGSA-DQP**
- **GDMS** generates query plan from query against global schema
- **DQP coordinator service** distributes query plan onto evaluation services
- Evaluation services execute parts of query plan in parallel.





@neurIST Semantic Technologies

● @neurIST Ontology

- Global “schema” of the disease
- Implemented in OWL-DL
- Incorporates existing ontologies
 - FMA (Foundational Model of Anatomy)
 - GO (Gene Ontology), DOLCE as Upper Ontology
 - Concepts mapped to UMLS (Unified Medical Language System)

● Semantic grid support (Ongoing Work!)

- Semantic **annotation** of services
- Semantic **service discovery** (semantic broker)
- Semantic **mediation** between data sources (generation of mapping files)
- Semantically supported data **querying**

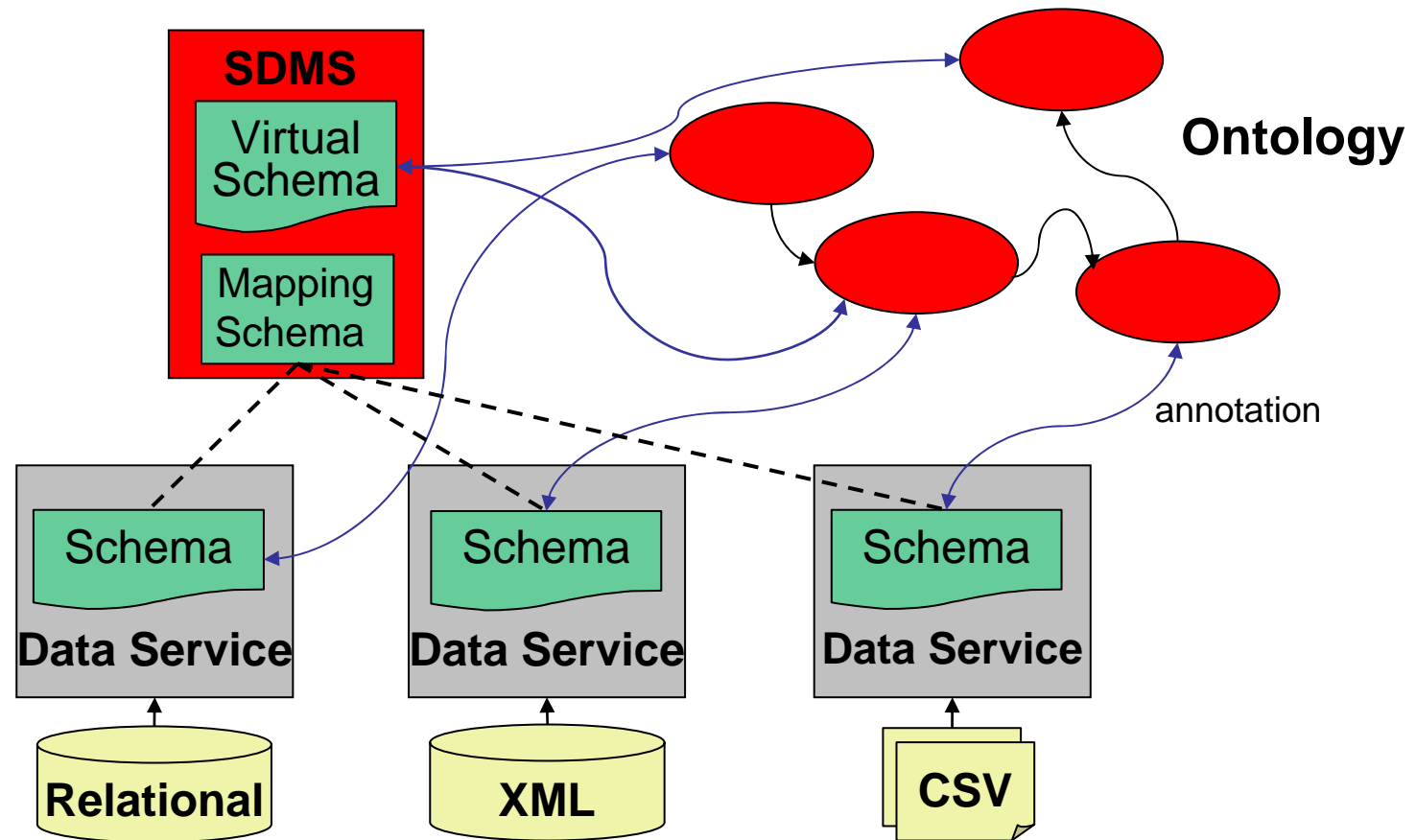
Conceptual space

- Clinical Medicine
- Molecular Biology
- Epidemiology
- Simulation
- Disease
- Risk factor

Classes	Relationship Types	UMLS Map
2139	85	1183



Semantic Data Mediation Services



- Keeps source data untouched (annotations stored in separate repository)
- Automatic generation of mapping schemas



@neurIST Security Architecture

- Pseudonymisation Service
- End-to-end security
- Attribute-based access control (SAML, XACML)
- Certificate and Registration Authorities; Federated VO model
- Security Token Service
- Logging, Filtering Services
- Auditing
- Provenance

built on top of Web services security standards.





Conclusions

• @neurIST Project

- Develops **generic Grid infrastructure** for the management and processing of heterogeneous data **for diagnosis and treatment development for multi-factoral diseases**.
- SLA-based **on-demand simulation and data-integration services** handling multi-scale, multi-modal information at distributed sites.

• @neurIST Grid Environment

- Compute and Data services with uniform interface based on WS-Standards
- leverages GEMSS, VGE, Fura and OGSA-DAI/DQP developments

• Future Challenges

- Semantic Grid Infrastructure, Ontologies
- Security, legal issues, provenance wrt. to patient data





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