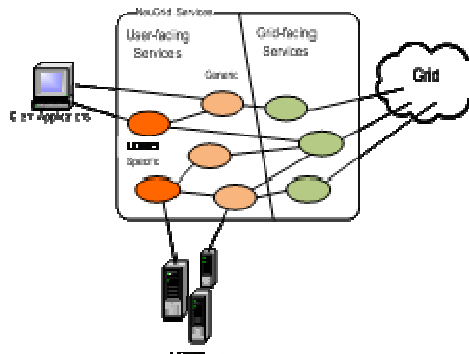# neuGRID

Summary: *neuGRID* is a new user-friendly Grid-based research e-Infrastructure enabling the European neuroscience community to carry out research required for the pressing study of degenerative brain diseases. In *neuGRID*, the collection/archiving of large amounts of imaging data is paired with computationally intensive data analyses. Neuroscientists will be able to identify neurodegenerative disease markers through the analysis of 3D magnetic resonance brain images via the provision of sets of distributed medical and Grid services. The infrastructure is designed to be expandable to services for other medical applications and is compliant with EU and international standards regarding data collection, data management, and Grid construction. *neuGRID* exploits experience developed during previous EC-funded project MammoGrid (providing knowledge related to the middleware and upperware that allow applications to talk to the Grid), and AddNeuroMed (collection/archiving/retrieval of multicentre clinical data, biomedical images and computerized image analysis). Key research challenges are: the gridification of the cortical thickness extraction algorithm pipeline, the development of a mid-layer of services between user-facing and grid-facing services to make the infrastructure expandable to a number of algorithm pipelines, and testing and validation of the prototype infrastructure. *neuGRID* aims to become the "Google for Brain Imaging", providing a centrally-managed, easy-to-use set of tools with which scientists can perform analyses and collaborate.

Objectives: *neuGrid* aims to deploy a 'Service Oriented Architecture' (SOA, see figure) to mediate between user applications, the backend system and other systems through the Grid. Functionalities are isolated and their interfaces are well defined, producing services suited to adaptability, re-use and scalability. The service architecture will pursue the following objectives:

• At the highest level, user-facing services are aimed to satisfy application (cortical thickness extraction) domain requirements, although with a view to make as many of them as possible aimed at a generic medical domain, increasing their chances of being reused in a later project.

• At the lower level, grid-facing services are formed from previously available software components, are Grid-knowledgeable and provide the interface to the selected Grid software (expected to be EGEE/gLite). These provide virtual file system access, mapping existing data available in the system to a common hierarchy that other centres may access, and job and query submission functions.

• Between these two layers there is a set of generic medical services including query services, image handling services and repository services, providing the functionality that spans re-usable medical applications independent of the underlying infrastructure (grid-agnostic).

Action plan: Phase 1 - Project Foundation by Month 12: Project management procedures; complete protocol specification to ensure privacy; report on distributed clinical/image dataset harmonized to international standards; dissemination and International Concertation plans and project training; distributed medical services design document; Grid test-bed installation report and Grid API specification; hardware specifications and test procedures; user requirements. Phase 2 - Project Deployment by Month 24: Interim evaluation of clinical/imaging datasets; brain imaging services specification; test and validation reports for the deployed infrastructure; revised user requirement document; Algorithms Toolbox Portfolio; AC/DC Test Series; *neuGRID* Beta release. Phase 3 - Project Final Phases by Month 36: Data protection/safety accomplishments; post-project sustainability ensured; generic services implemented; *neuGRID* successfully tested; final platform fully deployed and successfully tested.

Networking activities: Joint management and pooling of distributed resources. Establishment of

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Project acronym:
neuGRID

Contract n°: RI-211714

Project type: I3

Start date: 01/02/2008

Duration: 36 months

Total budget:
3 058 911 €

Funding from the EC:
2 800 000 €

Total funded effort in person-month:
405

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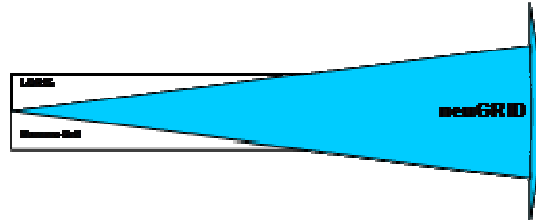tel.: +39 030 3501261
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Project participants:

FBF	IT
NE	CH
UWE	UK
MAAT	SP
VUmc	NL
KI	SW
HEALTHGRID	FR
CFc	IT

Keywords:
Grid Computing, Alzheimer's Disease, Computational Neuroscience

Collaboration with other EC funded projects:
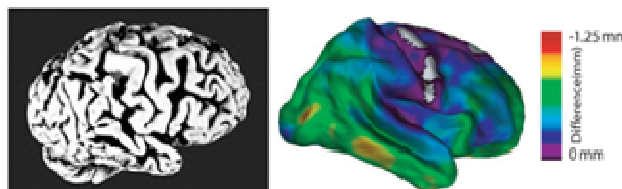ENIR, Innomed/AddNeuroMed, MammoGrid, Health-E-Child

an external review and advisory body, the Advisory Board, to ensure the project retains its scientific focus on the needs of its clinical community. Development of ethical standards and privacy protection protocols, and ensuring compliance with emerging Grids standards in healthcare. Establishment of a medical imaging database on which system validation and performance, and feasibility tests will be carried out. Delivery of sets of training courses. Active dissemination plan to prospective users, decision makers, and politicians. Promotion of clustering and concertation actions amongst other related projects. Coordination with national and international initiatives at the technical and clinical level.

Service activities: These make use of the experience and expertise acquired in the two successful existing e-Infrastructures LORIS and MammoGrid (see figure), the former specific to neurodegenerative diseases and providing data management and computing intensive community services, and the latter providing a generic set of services which optimizes and facilitates the use of a grid infrastructure. By merging the two, *neuGRID* results in a grid-based platform providing a large portfolio of services to different end-user communities. Activities are split into brain imaging services provision, distributed medical services provision, grid services provision, and deployment services provision.

Joint Research activities: P2 NE/P6 KI and P3 UWE/P4 MAAT will proceed with the following activities: (i) establish end-user needs and create an efficient environment for cooperative work, (ii) design and implement the technical integration of their systems, and (iii) conduct extensive validation studies. neuGRID must function in a manner transparent to the end-user at the front-end interface, producing results identical to the centralized NE system but without its computational speed or storage capacity potential limitations. The work plan is split into a set of three workpackages which break up the project work flow into logical phases of: needs assessment, technical evaluation, planning, and implementation; performance evaluation; and validation. Activities are split into user & system requirements analysis, algorithms and pipeline gridification, and prototype integration and validation.

User communities: The community whose needs *neuGRID* addresses are that of European neuroscientists working in the field of imaging of Alzheimer's disease (EADC-European Alzheimer's Disease Consortium and EADNI European Alzheimer's Disease Neuroimaging Initiative). Algorithm developers will have a powerful testbed as well as access to a large community of neuroscientists that might exploit their products. Prospective user communities are: pharma industry, that might wish to use the cortical thickness extraction (see figure) pipeline or other imaging markers running under *neuGRID* to study the effect of drugs on imaging markers of chronic brain diseases, and non neuroscientific communities such as cardiology and rheumatology, that are increasingly approaching the field of computational image analysis.

International aspects: *neuGRID* has a number of intrinsically tight international collaborative arrangements that come with the user community of neuroscientists involved in the project. The EADC – European Alzheimer's Disease Consortium – is the Consortium of excellent EU academic clinical centres working in the field of Alzheimer's disease. Worldwide ADNI – Alzheimer's Disease Neuroimaging Initiatives – are prospective studies of persons with memory disturbances or early Alzheimer's disease sharing a common clinical and image acquisition protocol. The Coordinator of neuGRID (IRCCS Fatebenefratelli) leads the imaging working group of the EADC and the European branch of the ADNI. The Montreal Neurological Institute is one of the most renowned centres in the world for brain imaging analysis and is linked to the neuGRID consortium for some key neuGRID personnel boast also an MNI affiliation.

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