From BIOPATTERN to Bioprofiling over Grid for e-Healthcare

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Outline of the talk

- Introduction
  - The BIOPATTERN project
  - Grand Vision
- Biopattern and Bioprofile
- Why over Grid?
- BIOPATTERN Grid
  - Prototype and services
  - An illustrative example
- Concluding remarks and future work

The BIOPATTERN Project

- EU FP6, 4-year, Network of Excellence (NoE), project within the ICT for Health

- Involves 30 partners from healthcare, academia and industry.

- Brings together researchers in medical informatics, bioinformatics, biosignal analysis and e-delivery technology

- Partners are from 11 countries

- More information at http://www.biopattern.org

BIOAPTTERN – Grand Vision

- "To integrate co-operative research aimed at a pan-European approach to coherent and intelligent analysis of a citizen's *bioprofile*; to make the analysis of this *bioprofile* remotely accessible to patients and clinicians; and to exploit the *bioprofile* information to combat major disease classes".

- Vision is long term, but it inspires short term objectives.

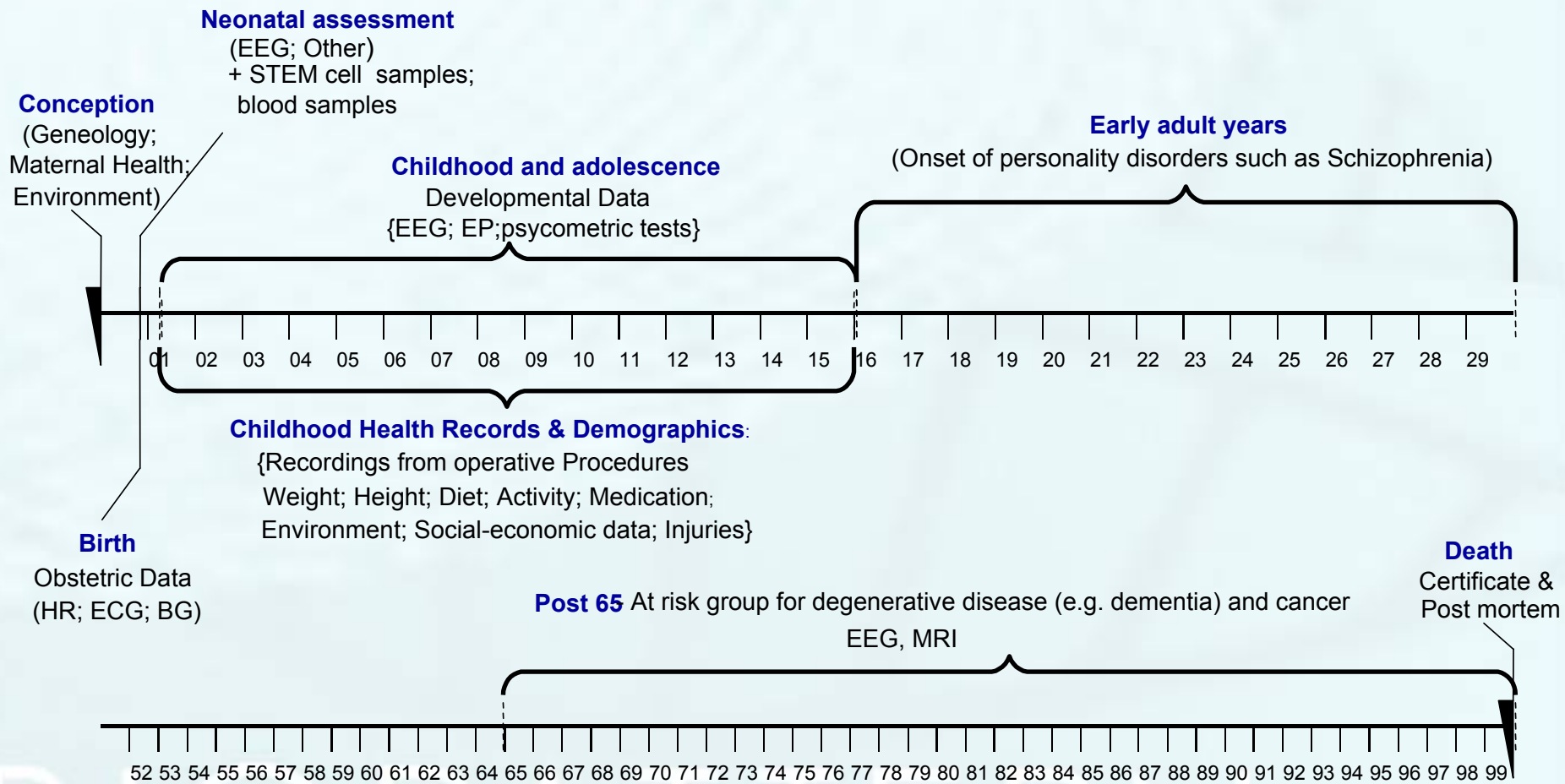# Biopattern and Bioprofile – what are they?

- Biopattern – basic information which provides clues about underlying clinical evidence for diagnosis and treatment.
  - A snapshot which includes features derived from data (e.g. genomics, EEG, ECG, imaging etc);
  - Often used for diagnosis and short-term patient monitoring

- Bioprofile – personal '*fingerprint*' that combines a person's bio-history and future prognosis.
  - Combines not only data, but also analysis and predictions of possible susceptibility to diseases.
  - Should drive personalised and better healthcare.

Some of the key areas in BIOPATTERN

- Bioprofiling for early detection and care for Alzheimer's disease.
- Early Life – fetal and neonatal bioprofiling assessing adverse events and their impact.
- Personalised care for breast cancer
- Personalised care for Leukaemia (in collaboration with GEMIMA Project)
- Personalised care for brain tumour (in collaboration with eTumour project).

Concept of bioprofiling – timeline

Neonatal assessment
(EEG; Other)
+ STEM cell samples;
blood samples

Conception
(Geneology;
Maternal Health;
Environment)

Early adult years
(Onset of personality disorders such as Schizophrenia)

Childhood and adolescence
Developmental Data
{EEG; EP;psycometric tests}

01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

Childhood Health Records & Demographics:
{Recordings from operative Procedures
Weight; Height; Diet; Activity; Medication;
Environment; Social-economic data; Injuries}

Birth
Obstetric Data
(HR; ECG; BG)

Death
Certificate &
Post mortem

Post 65 At risk group for degenerative disease (e.g. dementia) and cancer
EEG, MRI

52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99

Why over Grid?

- Conceptually, our interest is in "bioprofiling from birth to death"

- Bioprofiling databases are geographically distributed.

  – Mobility of a citizen (e.g. Mike's life journey)

  – Databases may be located at different countries/centres.

  – Collaboration and cooperation with partners across the EU, need sharing of resources (e.g. expertise, data and software/ algorithms).

France
(0-20)
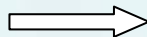
Germany
(20-40)

Italy
(40-60)
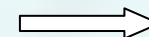
(60 --)

Mike's life journey

Why over Grid ? (cont)
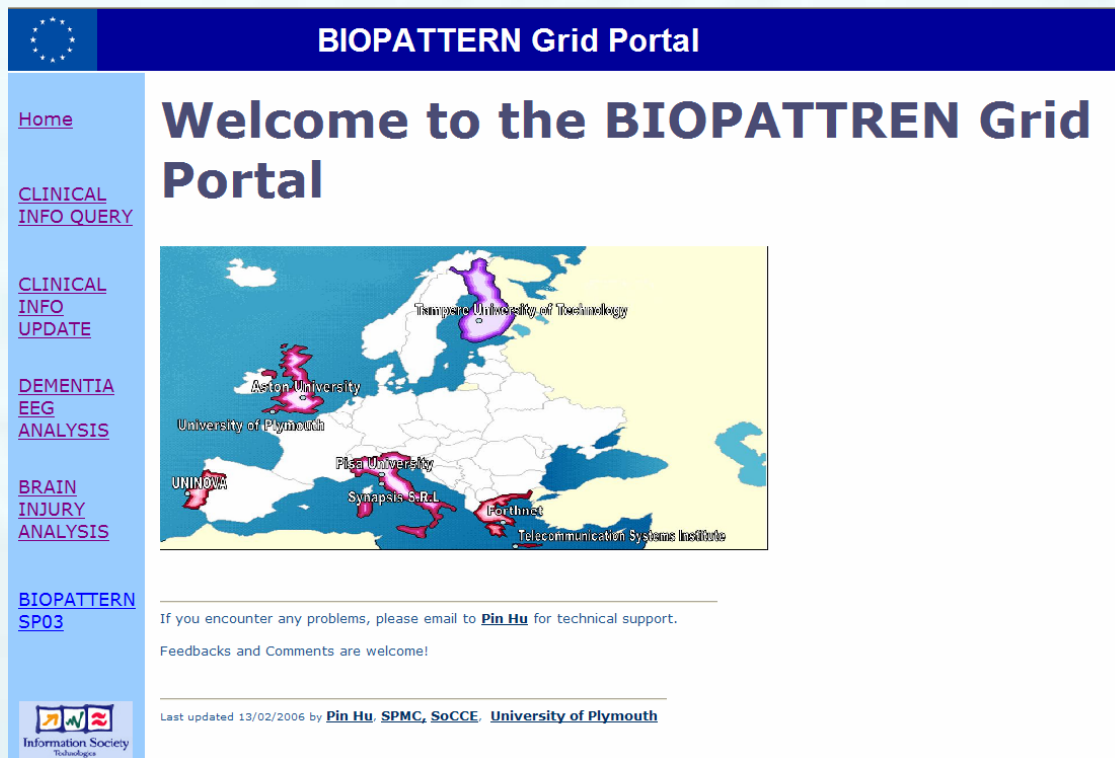
- Bioprofiling databases are huge, dynamic and distributed.
  - Databases are huge (e.g. serial MRI, EEG etc.)
  - Databases are dynamic (update of data at any time)
- Intelligent analysis of a huge database are computation intensive
  - For analysis of imaging data (e.g. MRI and CT)
  - For visualisation of large medical data set
  - For integration and fusion of data

Bioprofile over Grid – prototype
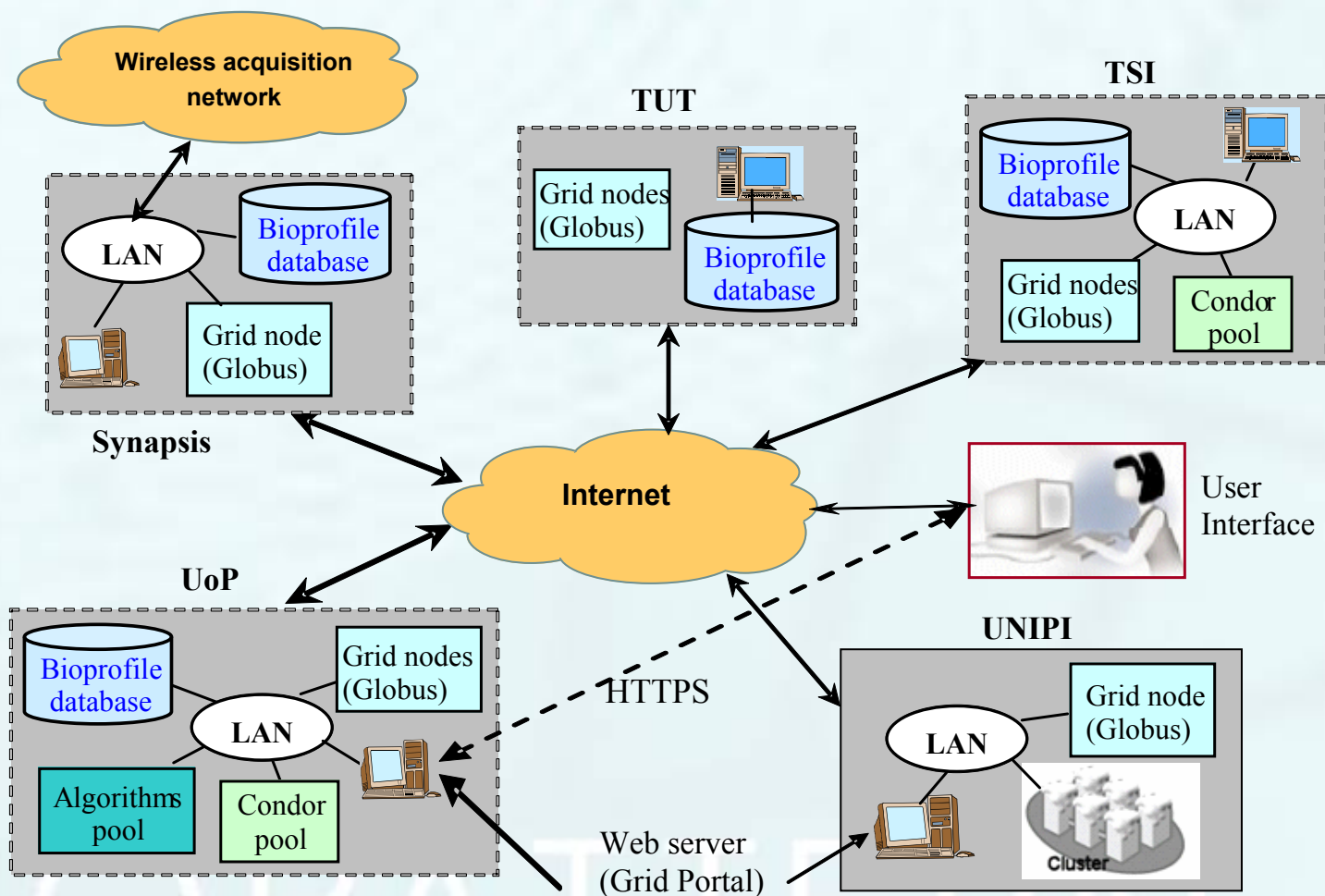
BIOPATTERN Grid services

- **High Level Services:** for end users to use grid-enabled services via the BIOPATTERN grid portal

Grid/Web Services:

- Data upload/update
- Data query
- Data analysis

BIOPATTERN Grid services (cont.)

- Low level (Grid level) services
  - For users to directly access grid resources
  - Services accessed via Globus containers
  - Data services

    (e.g. Remote data acquisition, which offers automated data acquisition, management and exchange)
  - Computational services

    (e.g. Crawling service, which provides a generic search engine to collect relevant specific documents, data etc.)
  - Management services

    (e.g. Workflow substitution and management services)

An illustrated example – bioprofile over grid for dementia
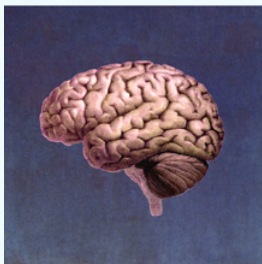
Dementia is a progressive, age-related neurodegenerative disorder associated with cognitive decline and aging.

It is common in the elderly. 10% of persons over age 65 and up to 50% over age 85 have dementia.

An illustrated example – bioprofile over grid for dementia (cont.)
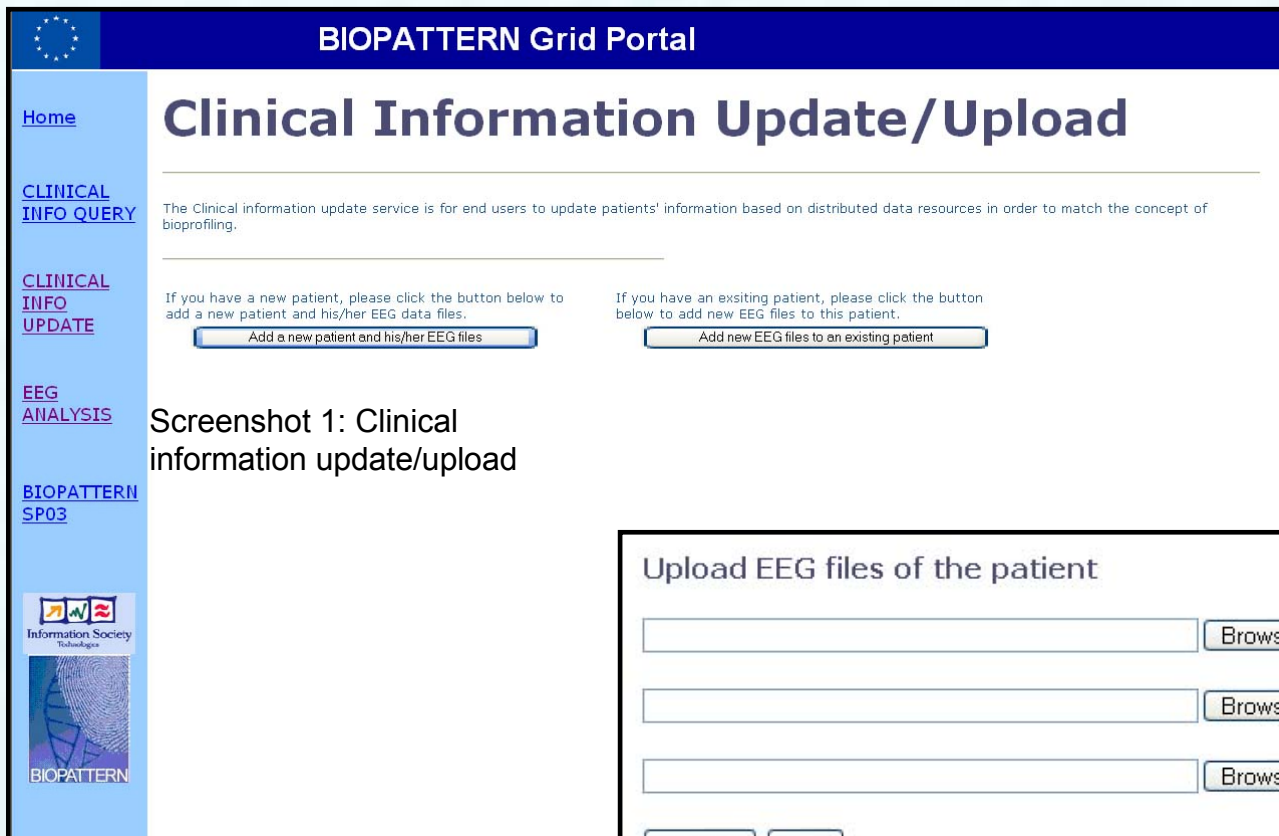
Detection of dementia by use of a biomarker derived from analysis of EEG

Index

Normal spread

Onset of disease

Index is abnormal

Time   (s)

BIOPATTERN Grid services for dementia
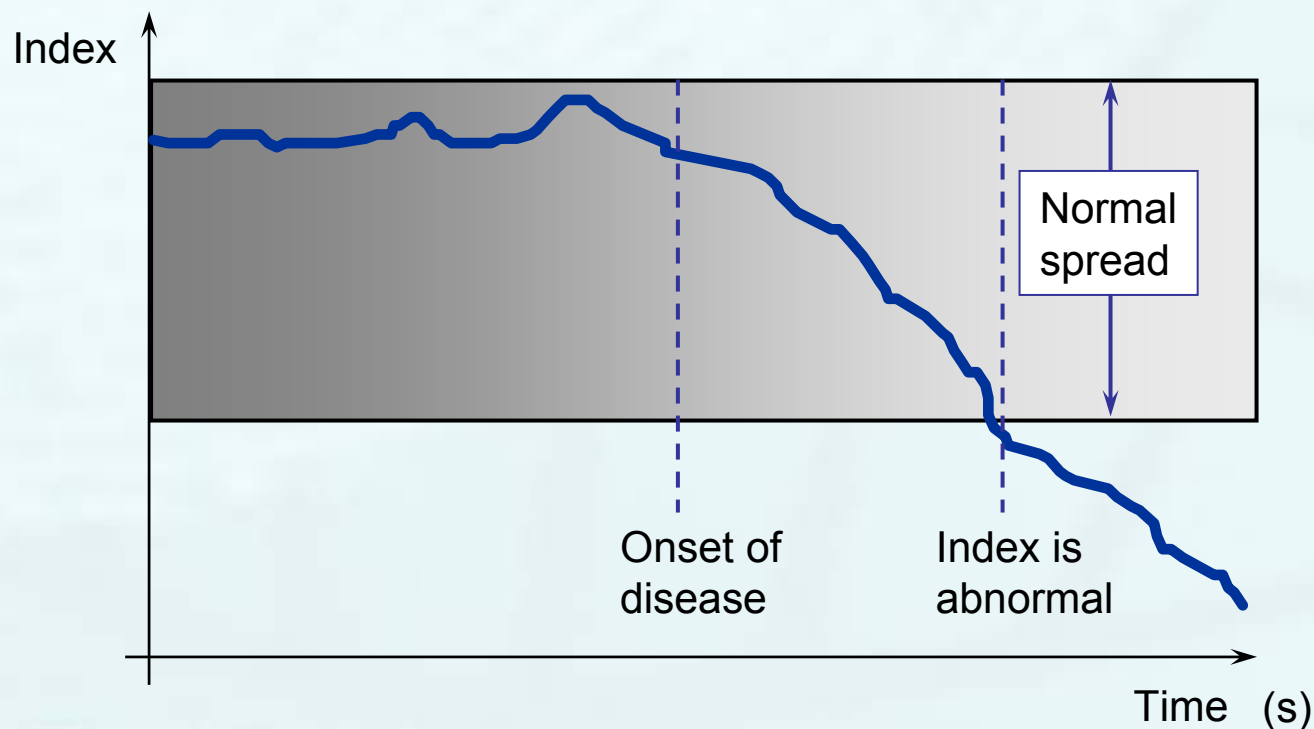
EEG analysis for early detection of dementia

Clinical info query Interface	EEG analysis interface	Analysis result display interface	*User GUI*
Query classes	Analysis classes	Result display classes	*Web services*

Workflow management services

Query services	Fractal dimension analysis service	Zero crossing analysis service
OGSADAI data services	Execution management services	

Grid services

OGSADAI-WSRF	GT4 core	WS-GRAM	*Grid middleware*

Bioprofile databases	Algorithm databases	Condor pool	Globus-based computational resources	*Grid resources*
Data resources		Computational resources		

Data Update/Upload Service

Screenshot 1: Clinical information update/upload

Screenshot 2: Uploading EEG files

Data Query Service
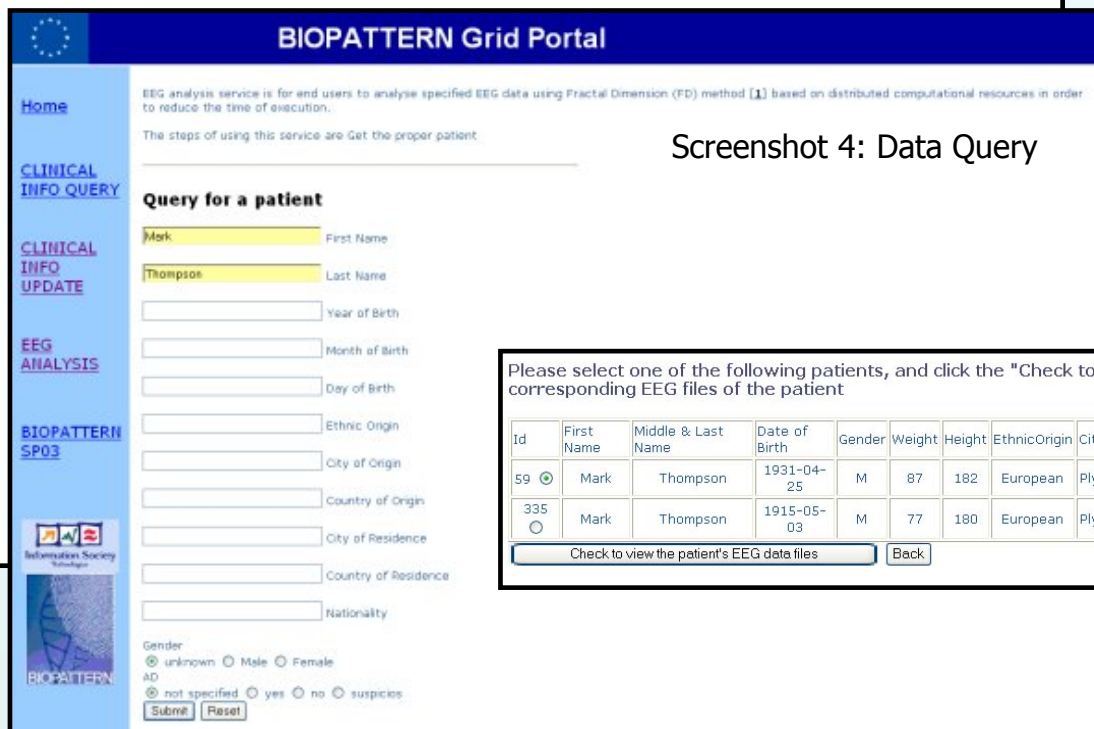
Screenshot 3: Log on screen

Screenshot 4: Data Query

Screenshot 5: Patient Select

Data Analysis Service

BIOPATTERN Grid Portal
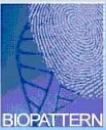
Home

CLINICAL
INFO QUERY

CLINICAL
INFO
UPDATE

EEG
ANALYSIS

BIOPATTERN
SP03

Please select any of the EEG files of the patient presented below, and click the "Analysis" button to analyse the EEG files you want
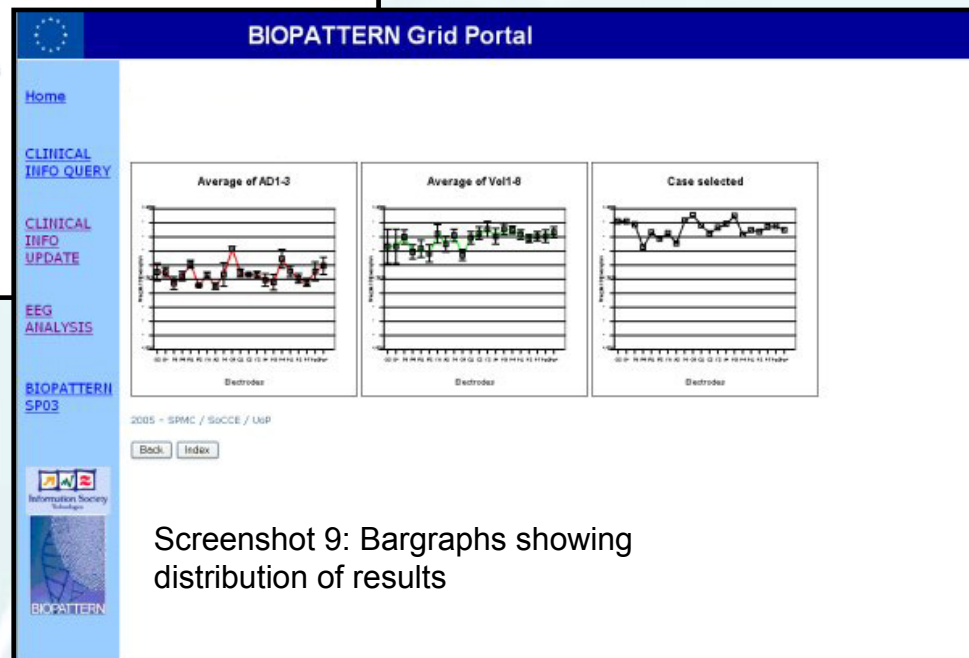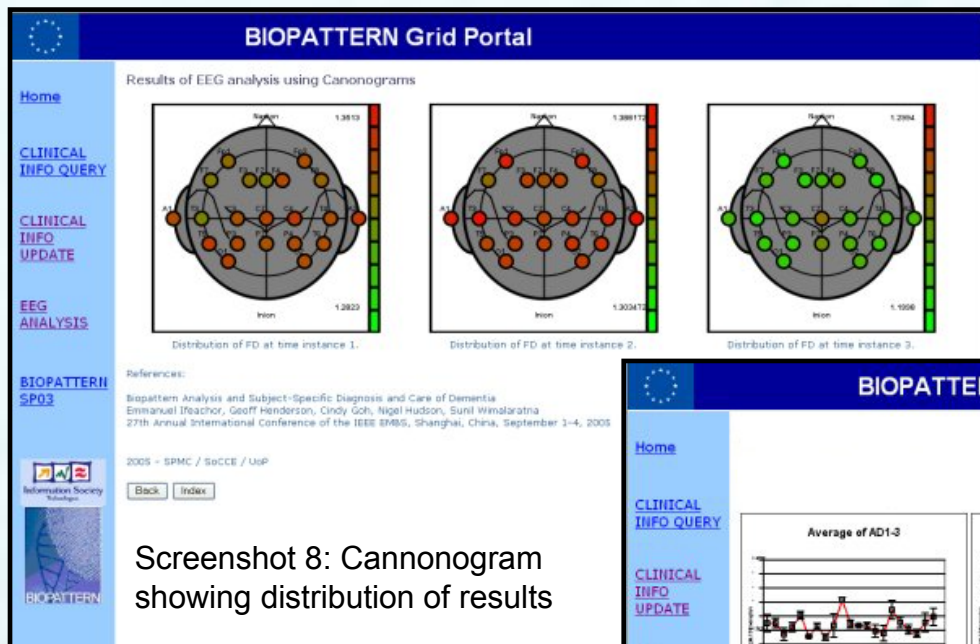
☑ SUBJECT59_1.EEE
☑ SUBJECT59_2.EEE
☑ SUBJECT59_3.EEE

[Analysis] [Back]

Screenshot 6: EEG files of patient selected for analysis

	AllBarF	ALL	Fp1	Fp2	F7	F3	FZ	F4	F8	A1	T3	C3	CZ	C4	T4
⦿	1.337066	1.352549	1.371960	1.364321	1.303472	1.342806	1.327207	1.340599	1.313018	1.374012	1.388172	1.362020	1.340559	1.355813	1.366128
◯	1.337066	1.352338	1.372058	1.341586	1.303472	1.342806	1.327207	1.340599	1.313018	1.374012	1.388172	1.362020	1.340559	1.355813	1.366128
◯	1.176887	1.200293	1.186417	1.173416	1.185030	1.180968	1.182130	1.185719	1.243716	1.183155	1.207245	1.275067	1.190550	1.200033	1.250014

[Canonogram] [Bargraph] [Back]

Screenshot 7: Analysis results - Fractal dimension of selected EEGs

Data Analysis Service – Viewing results

Screenshot 8: Cannonogram showing distribution of results

Screenshot 9: Bargraphs showing distribution of results

Concluding remards and future work

- Ongoing project
  - An integrated data, computation and knowledge grid environment
  - More and enhanced grid applications and services to support Bioprofiling (brain diseases and cancers)
  - Enhanced portal
- Move from research prototype to clinical prototype
  - Ethical and regulatory issues
  - Privacy, security and QoS issues
  - Scalability issues
  - Develop links with large Grid projects (e.g. EGEE, NGS, OMII)