



Developing a Roadmap for a European Healthgrid



HealthGrid and SHARE: retrospect and prospect for grids in health

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on behalf of the **SHARE Consortium**



<http://www.eu-share.org>



<http://www.healthgrid.org>

SHARE: Structuring and supporting Healthgrids Activities and Research in Europe

The Share project (FP6-2005-IST-027694) is funded by the European Commission Information Society and Media DG under the 6th Framework Programme.



EGEE User Forum 2008 - Clermont Ferrand





SHARE consortium



- EC Framework Programme 6 'Specific Support Action' project
- 27 months, January 2006 to March 2008
- with
- CNRS/IN2P3
- HealthGrid
- Universidad Politécnica de Valencia
- University of the West of England, Bristol
- Research Centre for Computer and Law (CRID) - University of Namur
- European Health Management Association
- Empirica GmbH
- Argonne National Laboratory
- Academia Sinica Grid Computing Centre
 - APAMI (Asia-Pacific Association for Medical Informatics)

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SHARE Objectives



- **SHARE** to define **milestones** for
 - wide deployment and adoption of **healthgrids in Europe**
 - action plan for a **European e-Health Area**
- The project had to
 - assess the **status quo** and set **targets**
 - identify key **gaps, barriers** and **opportunities**
 - establish
 - ▲ **short and long term objectives**
 - ▲ **key developments**
 - ▲ **actors to achieve the vision**





Background



- The concept of “**grids for health**” was described in the **HealthGrid White Paper** in 2005. It set out a vision of the opportunities and potential benefits offered by applying grids in different areas of biomedicine and healthcare.
- The HealthGrid vision relies on the setting up of grid infrastructures for
 - **medical research,**
 - **healthcare, and**
 - **the life sciences**
- **HealthGrid** itself arose from a number of projects in grid applications to medicine and healthcare from about 2001 onwards. They spanned:
 - **health informatics:** screening, epidemiology, public health, etc.
 - **clinical informatics:** diagnostics, decision support, care planning, etc.
 - **biomedical informatics:** a new field!

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Background



- “Grid infrastructures for biomedical informatics” implies:
 - the availability of **grid services**, most notably for **data** and **knowledge management**;
 - the **deployment** of these services on infrastructures involving **healthcare centres** (e.g. hospitals), **medical research laboratories** and **public health** administrations; and
 - the definition and adoption of international **standards** and **interoperability** mechanisms for medical information stored on the grid.
- **Biomedical informatics**
 - a concurrent development
 - convergence and synergy between medical informatics and bioinformatics
 - leading to two new approaches to medicine ...

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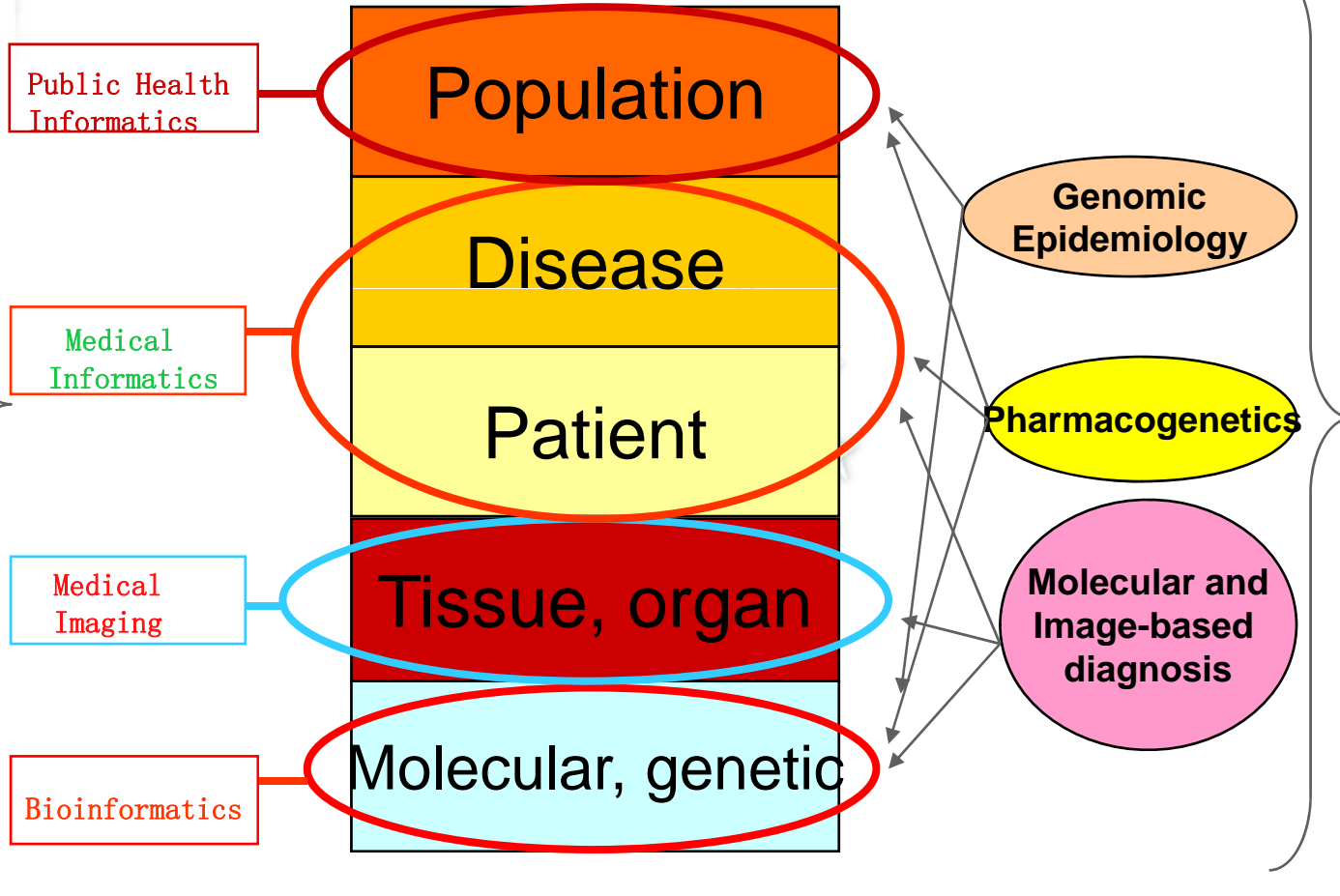


Biosocial organization,
knowledge & pathology

SHARE
A Roadmap for a European HealthGrid

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Taken from Fernando Martín-Sánchez

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Human Genetic Variation

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Technologies

Data

Applications

Genomic medicine

Information

Genotyping
Haplotyping

Individual genomics (SNPs and mutations)

Diagnosis
Pharmacogenetics

Individualised healthcare



Molecular medicine

Preventive medicine

BIOINFORMATICS & MEDICAL INFORMATICS

Gene Expression
DNA arrays
MS, 2D eph

Functional genomics
proteomics

Disease reclassification
Pharmacogenomics

Molecular causes of diseases

Genomic

Clinical

Taken from Fernando Martín-Sánchez

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SHARE Objectives



- **SHARE** to define
 - *what* has to be done,
 - *when* - and in what *sequence*,
 - by *whom*,
 - and *how*?
- Turns out action required in several domains:
 - **technical** research and development
 - **standards** and **security** for real world deployment
 - squaring up to **ethical** and **legal** issues
 - **community** acceptance and economic **investment**

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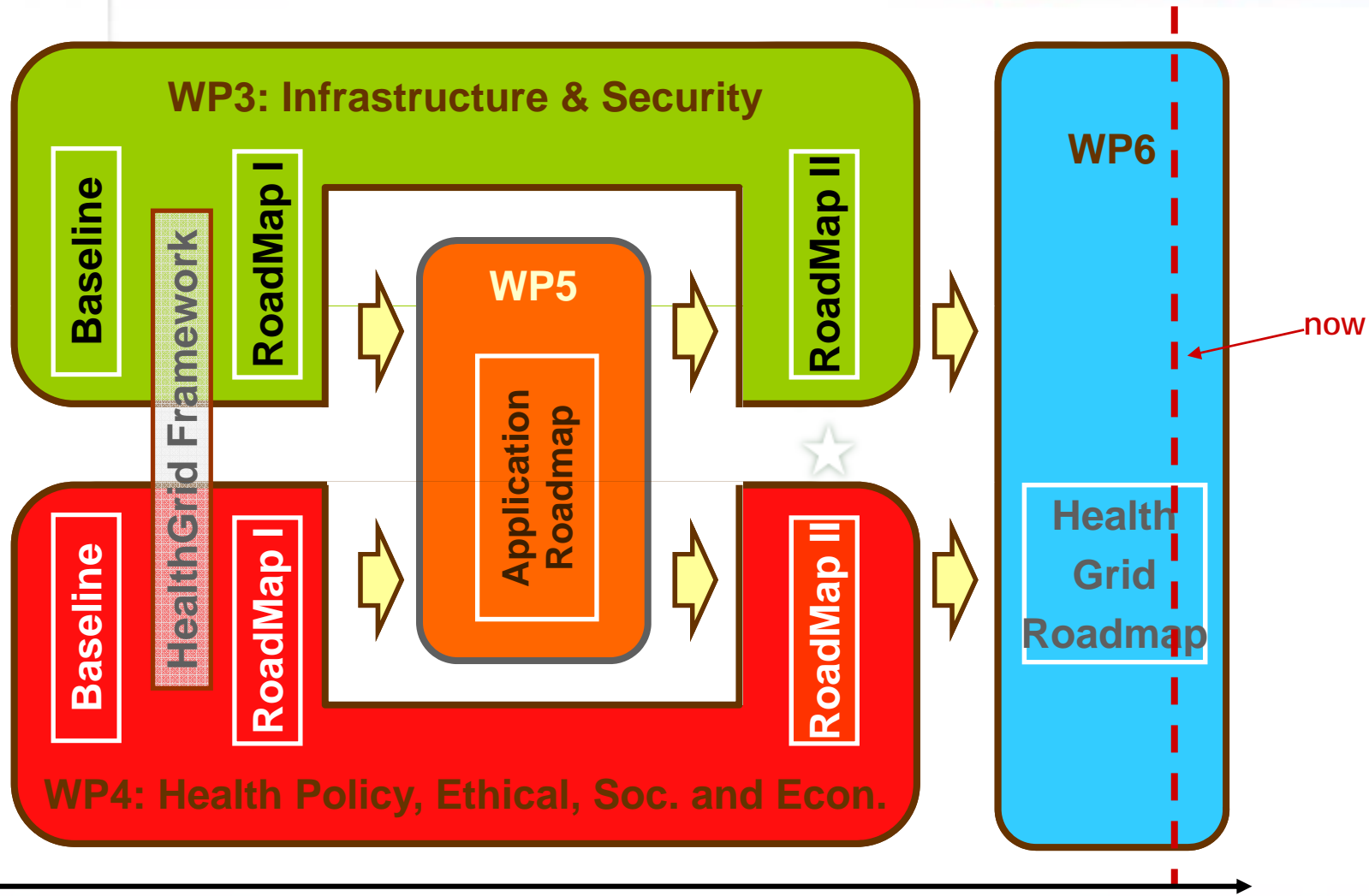




SHARE WPs

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What is the goal ?



An environment, created through the **sharing of resources**, in which **heterogeneous** and **dispersed** health data at different **levels**:

- molecular data (e.g. genomics, proteomics)
- cellular data (e.g. pathways)
- tissue data (e.g. cancer types, wound healing)
- personal data (e.g. EHR)
- population (e.g. epidemiology)

as well as **applications**, can be accessed by all users as a tailored information system according to their level of **authorisation** and without loss of **quality** of information or service.





Technical Challenges



- Distributed data integration and computing
 - **Security**
 - **Performance**
 - **Usability**
- Standards
 - Need for **reference** implementations of **standard grid services**
 - Bridge the gap between medical informatics standards and grid **standards** (e.g. grid-enabled DICOM)
 - Lack of **standard open source ontologies** in medical informatics
- Grid deployment in medical research centres
 - Easy installation of **secure grid nodes**
 - Friendly **user interface**



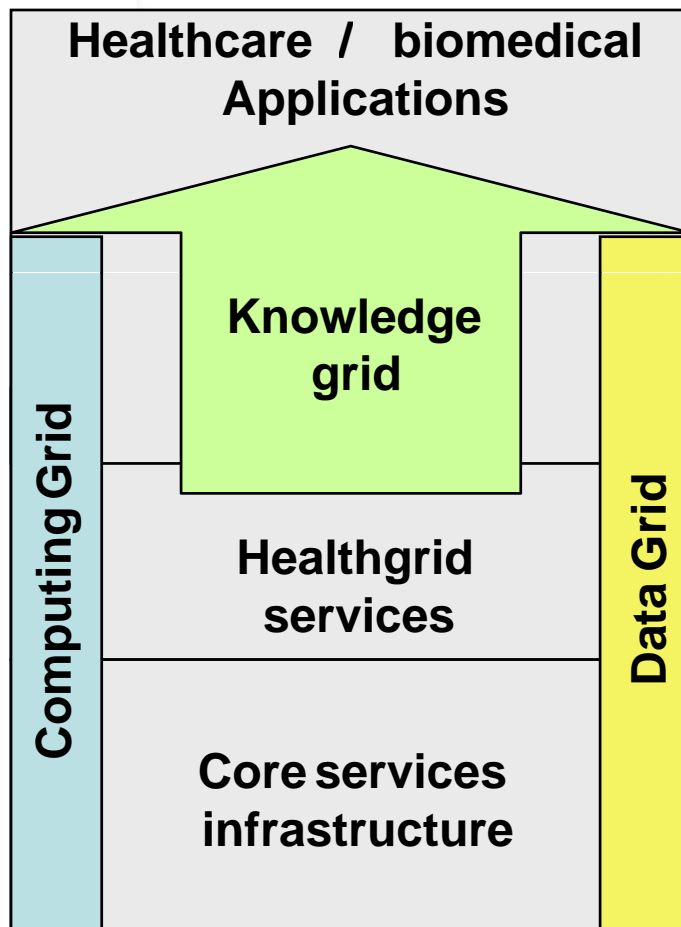


Other challenges



- Specific features of the community
 - Patient **ownership** of her or his data
 - Hospitals **IT policies vs grids**
- **Technology transfer** between projects
- Development of best practices
 - **Interfacing** IT resources for clinical routine to grid
 - **Data** sharing (and major **ethical** implications)
- Raising awareness of grids
 - Need to build on **success stories**

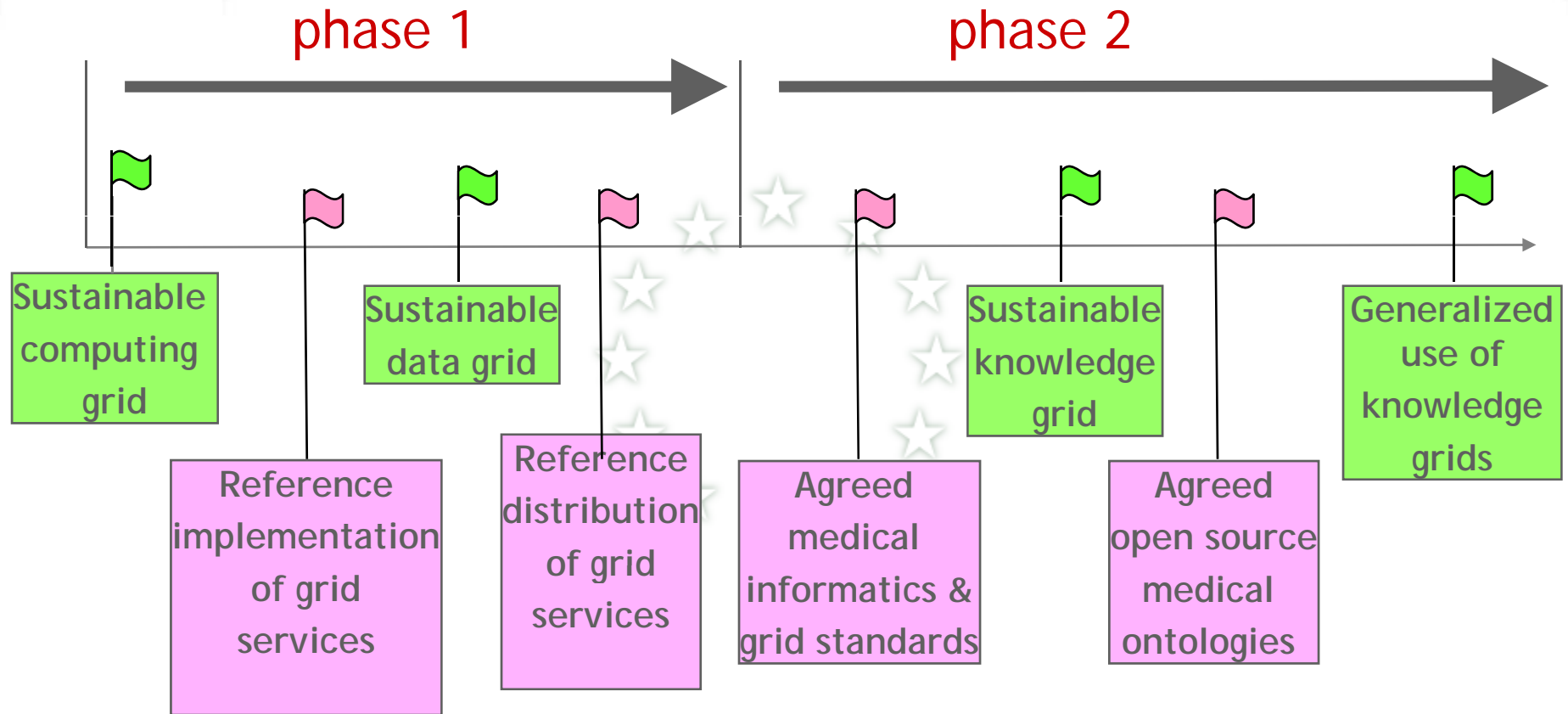




- The classic grid architecture assumed by SHARE
 - Core services are generic; no medical or healthcare specialization assumed
 - Healthgrid services are generic services (e.g. pseudonymization, image storage) and may be used by different special applications
 - Domain-specific applications may require additional services (e.g. mammogram standardization); these may also be made generic.



Toward a roadmap



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Milestones I



- In the first phase:
 - GD.1 A **sustainable computing grid infrastructure** for the medical research community
 - IT.1 A **reference implementation of grid services** using standard web service technology and allowing computation and secure manipulation of distributed data
 - GD.2 A **sustainable data grid** for a **well defined medical research topic**
 - ▲ **Distributed storage and distant query of medical data**
 - IT.2 A **reference distribution** of a reference implementation of grid services for the installation of grid nodes in medical research centres





Milestones II



- In the second phase:
 - IT.3 An agreed **set of standards** for sharing medical images and records on the grid
 - GD.3 A **knowledge grid** for a **well defined medical research topic**
 - ▲ **Distributed data integration and computing**
 - IT.4 Agreed and implemented **open source medical ontologies**
 - GD.4 **Generalized use** of knowledge grids






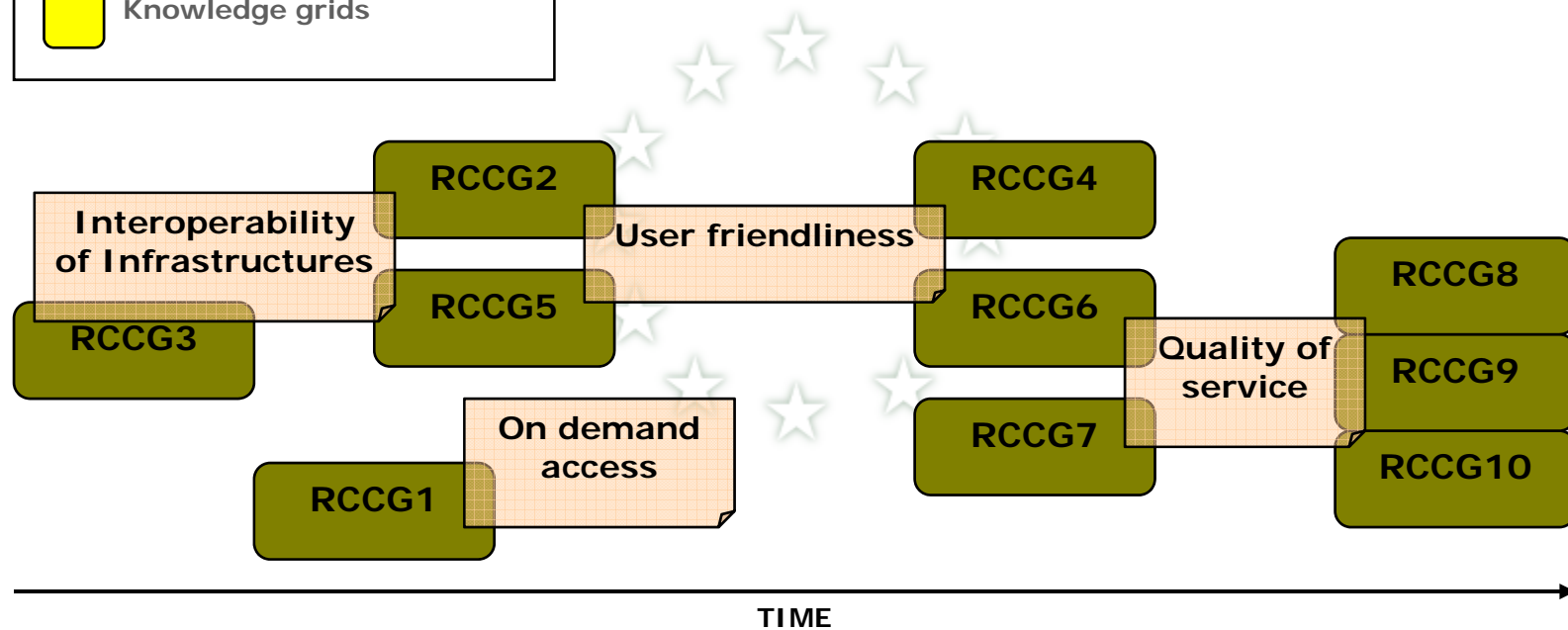


Computational Grids



Research challenges for:

-  Computing grids
-  Data grids
-  Knowledge grids



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Computational Grids



Challenge	Community	Description of the requirement
RCCG1	VPH	<ul style="list-style-type: none"> • Access to grid resources on demand.
RCCG2	VPH	<ul style="list-style-type: none"> • Transparent job submission to cluster and supercomputer grids. • Easy transfer of tasks between grid infrastructures
RCCG3	VPH	<ul style="list-style-type: none"> • Automatic migration of simulations between different scales.
RCCG4	VPH	<ul style="list-style-type: none"> • User friendly access. Lower barrier to adoption.
RCCG5	VPH	<ul style="list-style-type: none"> • Transparent access to different grids.
RCCG6	EPI	<ul style="list-style-type: none"> • Need for real fault-tolerant scheduling systems.
RCCG7	EPI	<ul style="list-style-type: none"> • Easily installed grid middleware for health environments. • Low maintenance and administration.
RCCG8	EPI	<ul style="list-style-type: none"> • Exploitation models and guaranteed QoS for services. • Advance resource reservation with pre-negotiated QoS.
RCCG9	EPI	<ul style="list-style-type: none"> • Need for scalable job scheduling system.
RCCG10	EPI	<ul style="list-style-type: none"> • Low latency/high performance services integrated.

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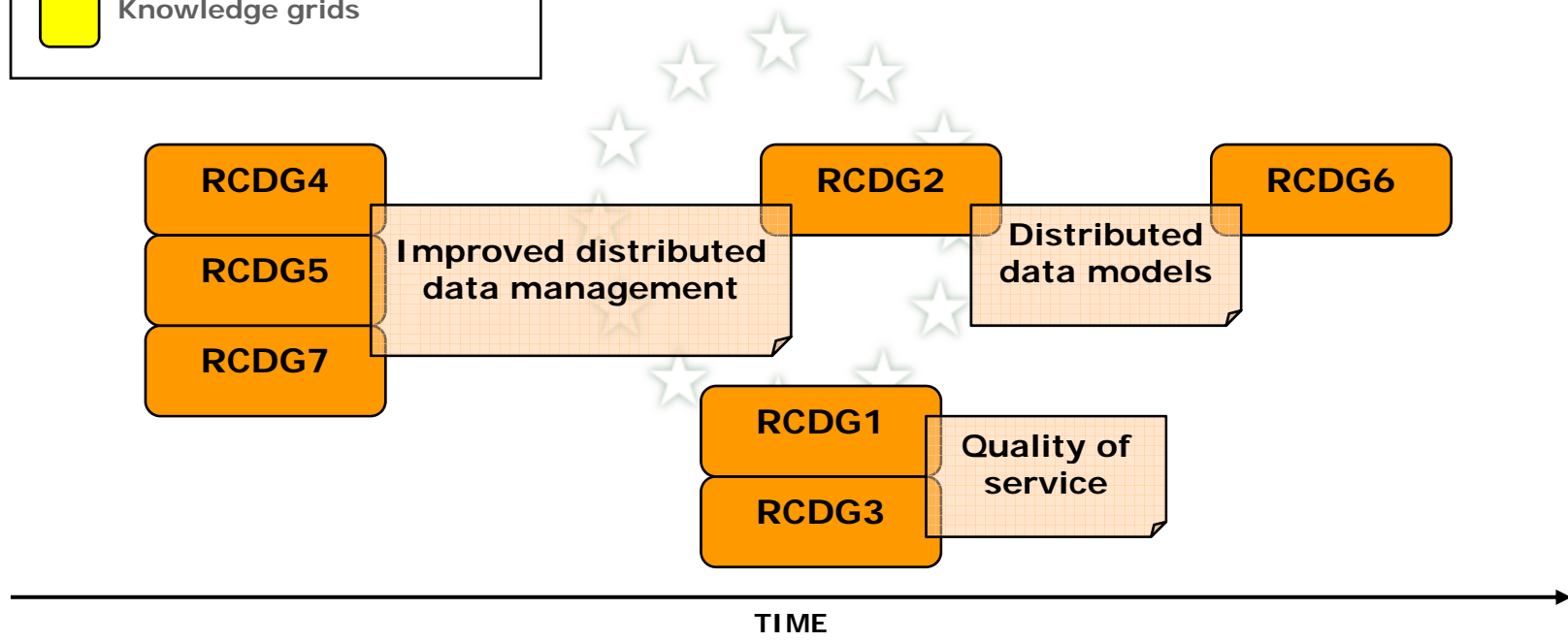


Data Grids



Research challenges for:

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Data Grids

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Challenge	Community	Description of the requirement
RCDG1	EPI	<ul style="list-style-type: none"> Easily installed grid middleware for health environments. Low maintenance and administration.
RCDG2	EPI - VPH	<ul style="list-style-type: none"> Data architectures/tools for private data dissociation, pseudo/anonymisation and encryption. Automatic compliance with legal requirements.
RCDG3	EPI	<ul style="list-style-type: none"> Exploitation models and guarantees QoS for services. Advance resource reservation with pre-negotiated QoS.
RCDG4	EPI	<ul style="list-style-type: none"> Scalable data cataloguing and data transfer.
RCDG5	VPH	<ul style="list-style-type: none"> Storage services for easy upload/download of large binary objects.
RCDG6	VPH / EuroPhysiome	<ul style="list-style-type: none"> Distributed data models and repositories multiscale data.
RCDG7	IMI	<ul style="list-style-type: none"> Enhanced standards for data protection in web services environments.

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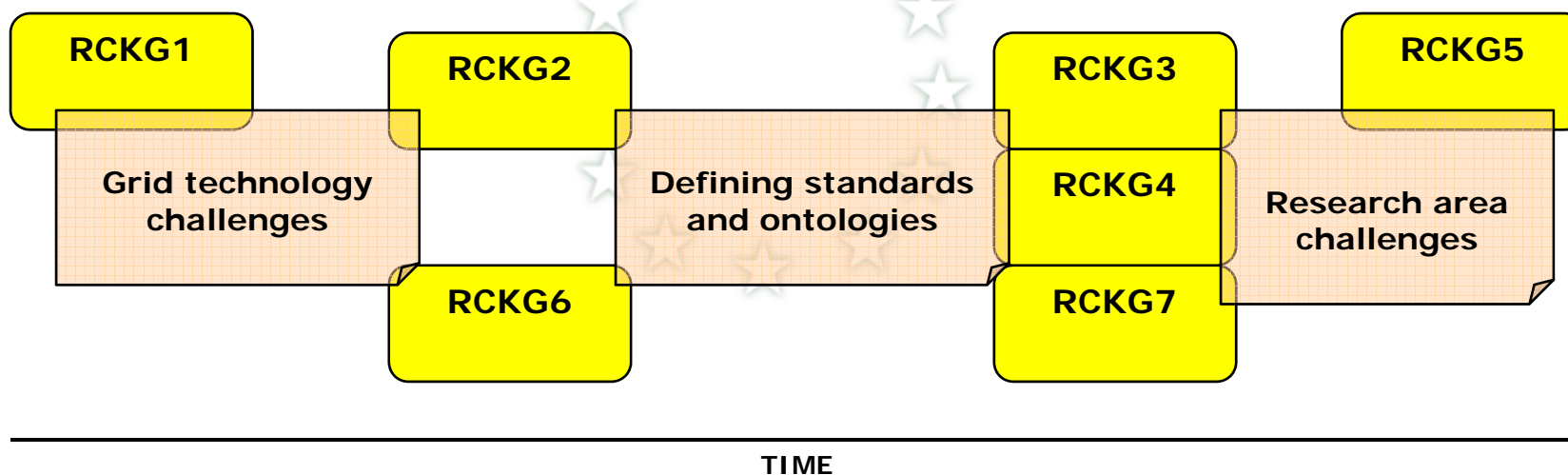
Knowledge Grids

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Research challenges for:

-  Computing grids
-  Data grids
-  Knowledge grids



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Knowledge Grids



Challenge	Community	Description of the requirement
RCKG1	EPI	<ul style="list-style-type: none"> Knowledge-driven grid catalogues and integration based on the metadata.
RCKG2	IMI	<ul style="list-style-type: none"> Standards and models to expose web services (semantics), scientific services, properties of data sources, data sets, scientific objects, and data elements
RCKG3	IMI	<ul style="list-style-type: none"> Enhanced knowledge representation models and data exchange standards for complex systems
RCKG4	IMI	<ul style="list-style-type: none"> Develop new, domain-specific ontologies based on standard data representation models and reference ontologies
RCKG5	IMI	<ul style="list-style-type: none"> Advanced text mining tools to capture implicit information about complex objects, relationships and processes, as described in patents and literature
RCKG6	IMI	<ul style="list-style-type: none"> Standards and an expert tool (ontology/schema/rules negotiator) to expose properties of local sources in a federated environment
RCKG7	IMI-VPH	<ul style="list-style-type: none"> Standards and an expert tool (services/data negotiator) to guide users through the complexities of the data, data models, simulation and modelling tools.

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Revisiting User Reqs



Collaboration Grid
For e-science/e-health

Data Grid
Distributed and optimized storage of
large amounts of accessible data

Computing Grid
For data crunching applications

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Revisiting User Reqs

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A Roadmap for a European HealthGrid

Collaboration Grid
For e-science/e-health

Knowledge grids a level up

Data Grid
Distributed and optimized storage of
large amounts of accessible data

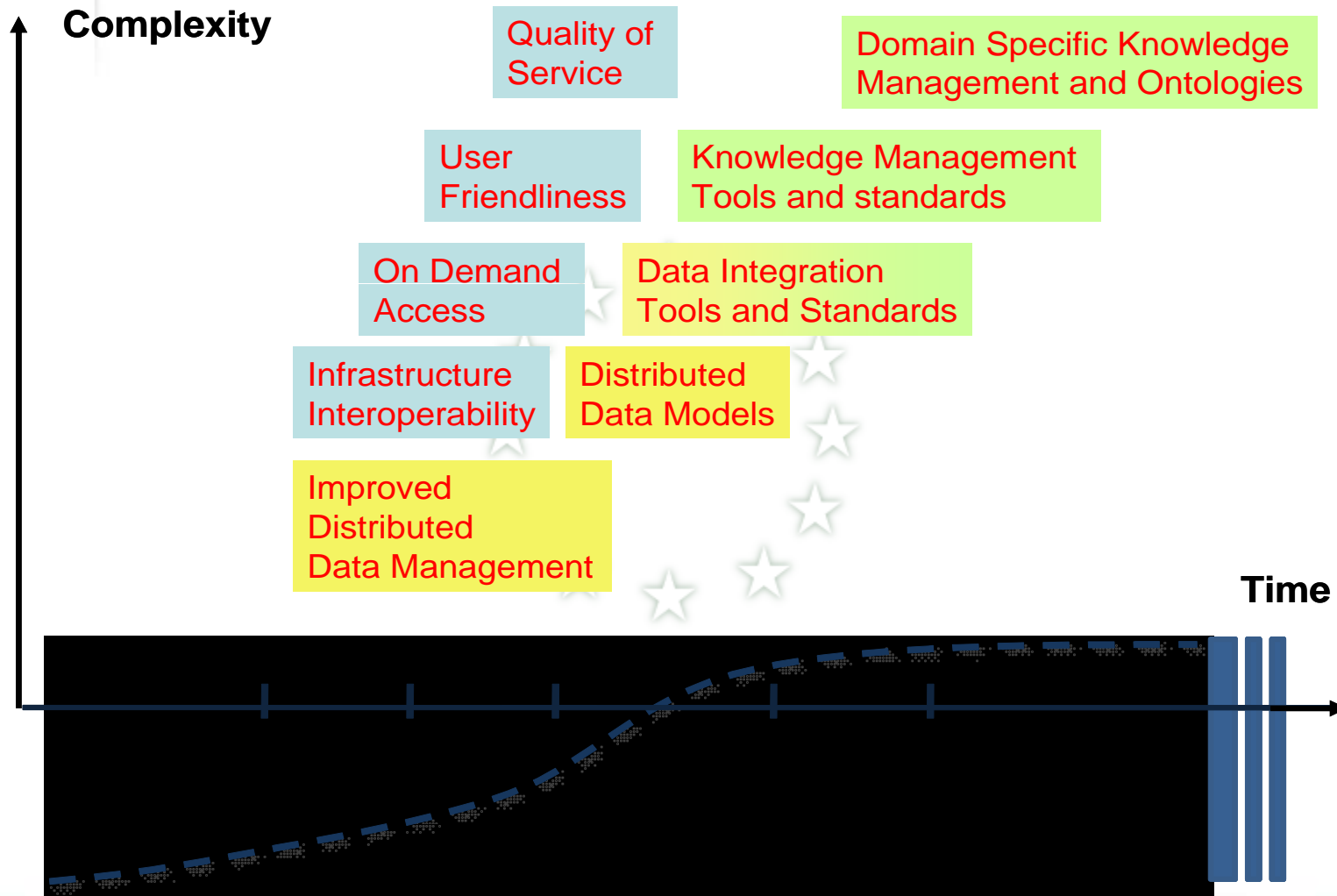
Computing Grid
For data crunching applications

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Challenges & complexity



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