An Overview of the GridWay Metascheduler

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<City>, <Country>
<Month> <day>, <year>

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What is GridWay?

GridWay is a Globus Toolkit component for meta-scheduling, creating a scheduler virtualization layer on top of Globus services (GRAM, MDS & GridFTP)

- For **project and infrastructure directors**
  - GridWay is an open-source community project, adhering to Globus philosophy and guidelines for collaborative development.
- For **system integrators**
  - GridWay is highly modular, allowing adaptation to different grid infrastructures, and supports several OGF standards.
- For **system managers**
  - GridWay gives a scheduling framework similar to that found on local LRM systems, supporting resource accounting and the definition of state-of-the-art scheduling policies.
- For **application developers**
  - GridWay implements the OGF standard DRMAA API (C and JAVA bindings), assuring compatibility of applications with LRM systems that implement the standard, such as SGE, Condor, Torque,...
- For **end users**
  - GridWay provides a LRM-like CLI for submitting, monitoring, synchronizing and controlling jobs, that could be described using the OGF standard JSDL.

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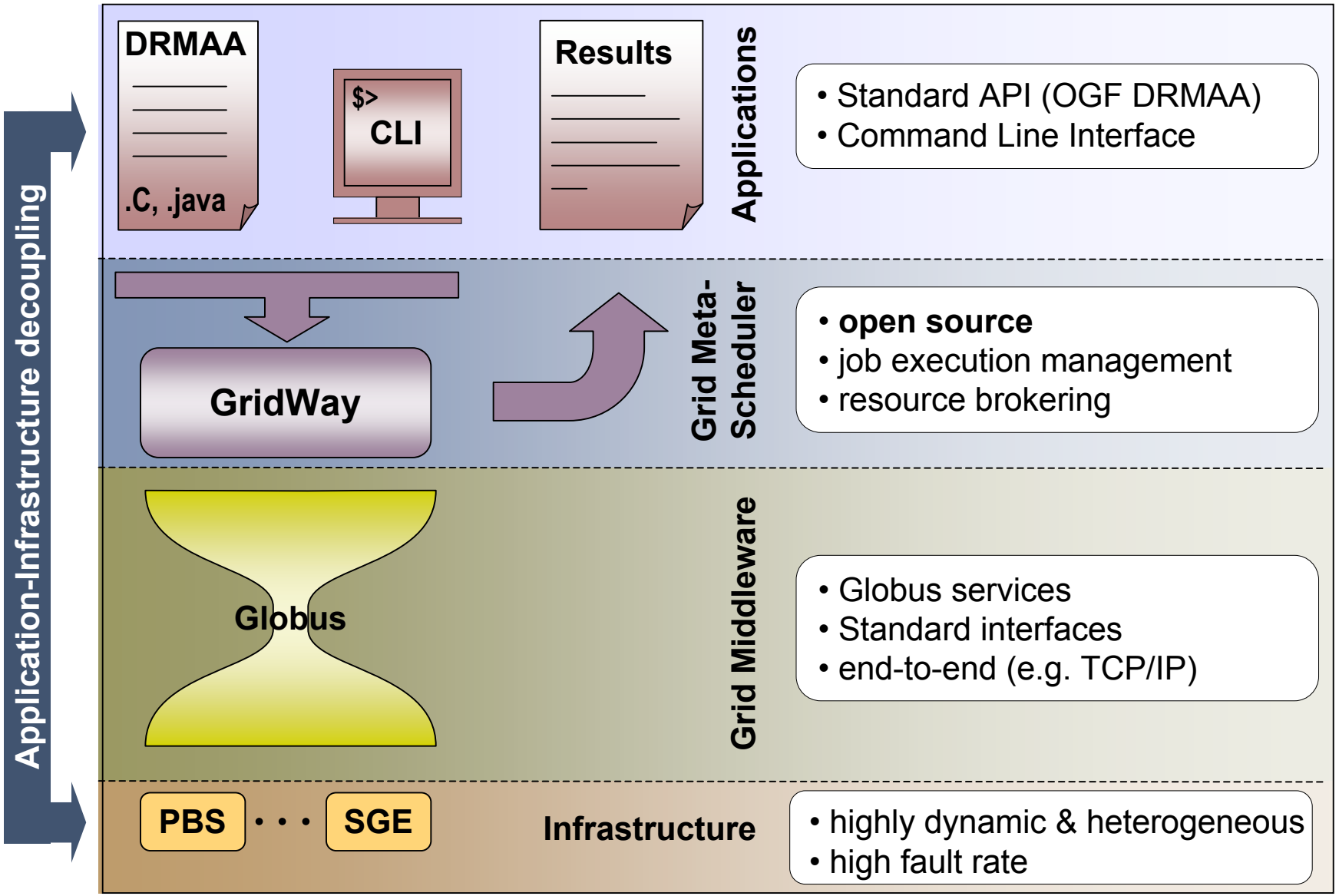
A Global Vision

Global Architecture of a Computational Grid



A Global Vision

Benefits

Integration of non-interoperable computational platforms (Organization)

- Establishment of a uniform and flexible infrastructure
- Achievement of greater utilization of resources and higher application throughput

Support for the existing platforms and LRM Systems (Sys. Admin.)

- Allocation of grid resources according to management specified policies
- Analysis of trends in resource usage
- Monitoring of user behavior

Familiar CLI and standard APIs (End Users & Developers)

- High Throughput Computing Applications
- Workflows

A Global Vision

Features

Workload Management

- Advanced (Grid-specific) scheduling policies
- Fault detection & recovery
- Accounting
- Array jobs and DAG workflows

User Interface

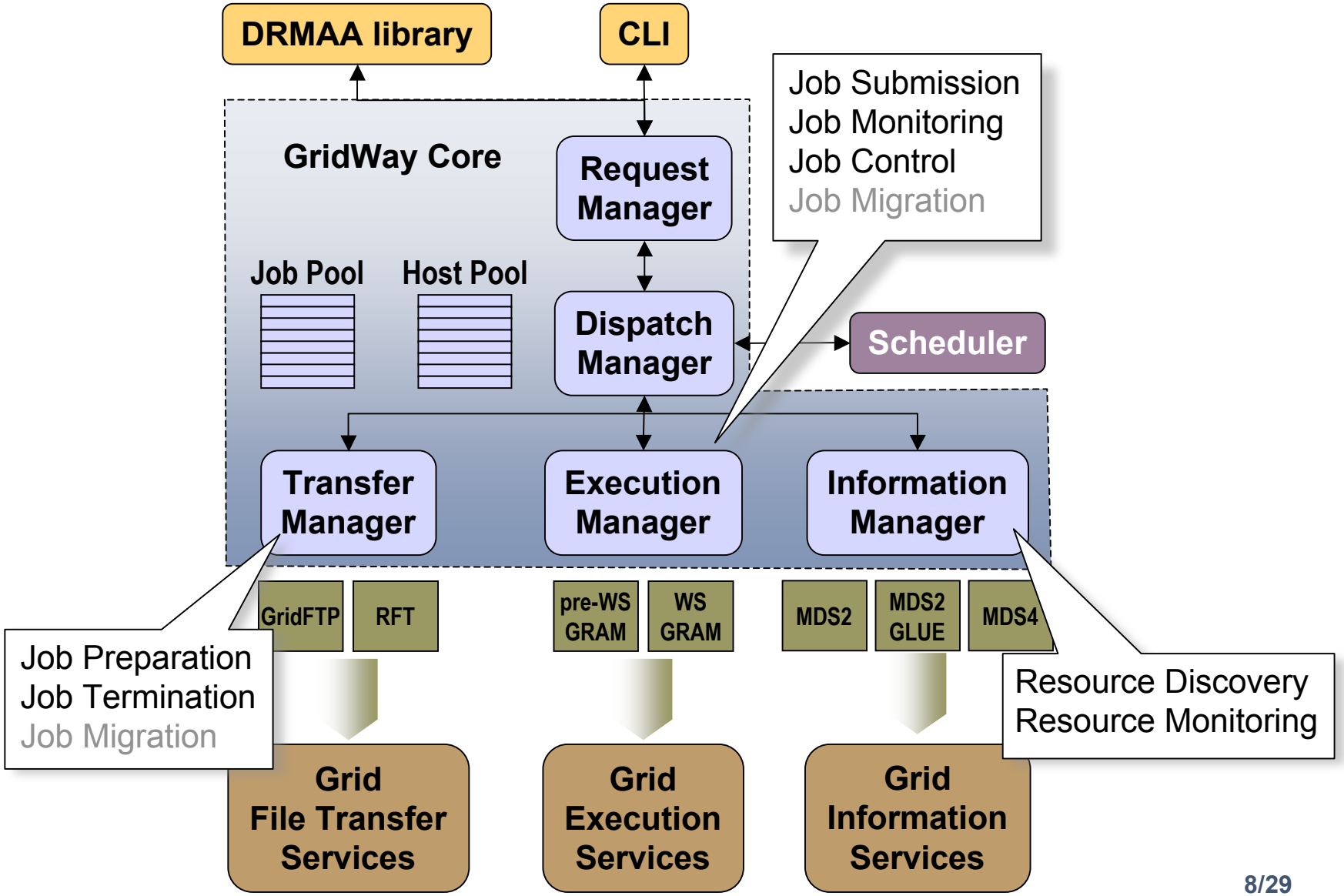
- OGF standards: JSDL & DRMAA (C and JAVA)
- Analysis of trends in resource usage
- Command line interface, similar to that found on local LRM Systems

Integration

- Straightforward deployment as new services are not required
- Interoperability between different infrastructures

A Global Vision

GridWay Internals



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Scheduling Policies

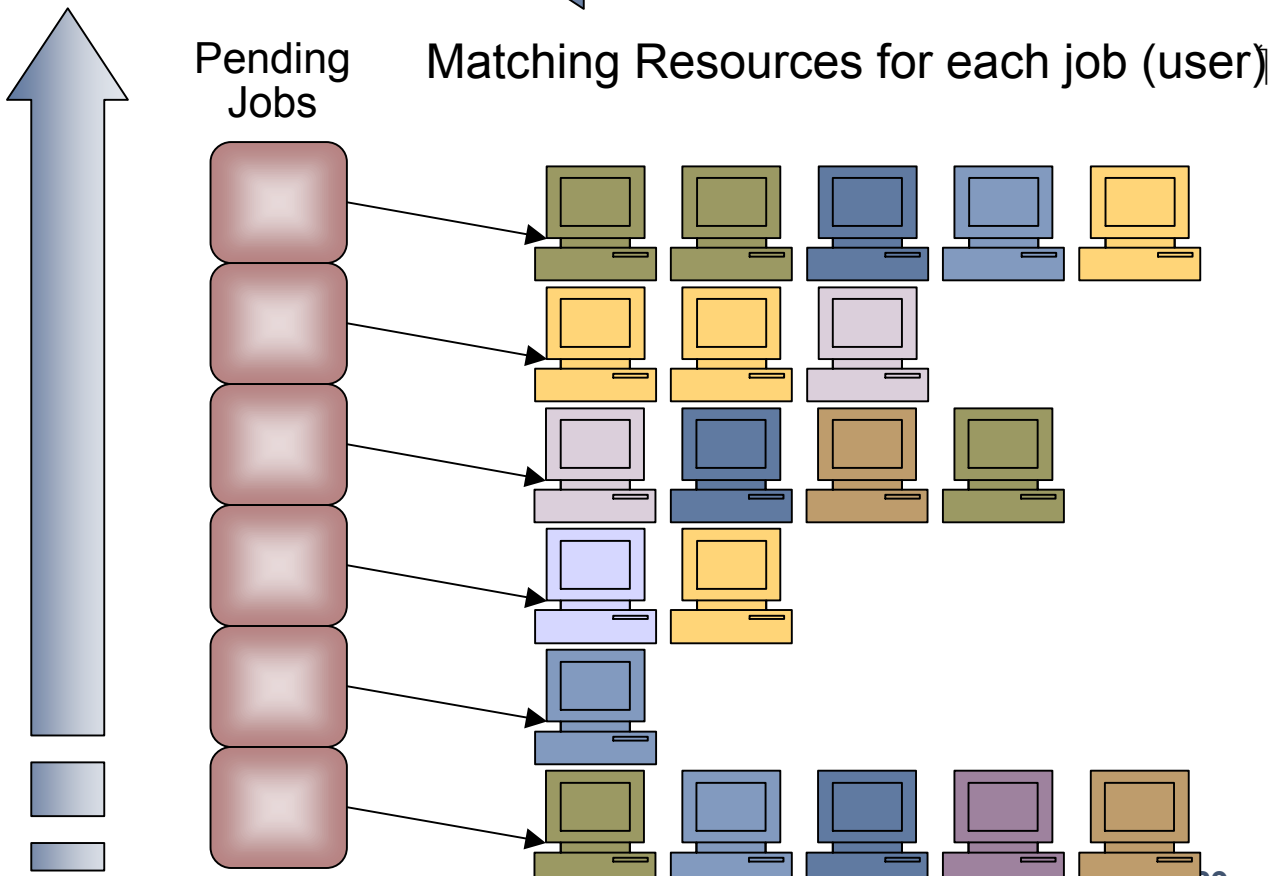
Resource Policies

- Rank Expressions
- Fixed Priority
- User Usage History
- Failure Rate

Grid Scheduling = Job + Resource Policies

Job Policies

- Fixed Priority
- Urgent Jobs
- User Share
- Deadline
- Waiting Time



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Scheduling Infrastructures

Centralized Coupled ← • Network Links • Administration • Homogeneity → **Decentralized Decoupled**

SMP (Symmetric Multi-processors)	MPP (Massive Parallel Processors)	Clusters	Network Systems Intranet/Internet	Grid Infrastructures

High Performance Computing

High Throughput Computing

Enterprise Grid Infrastructures

Characteristics

- "Small" scale infrastructures (campus/enterprise) with one meta-scheduler instance providing access to resources within the same administration domain that may be running different DRMS and be geographically distributed

Goal & Benefits

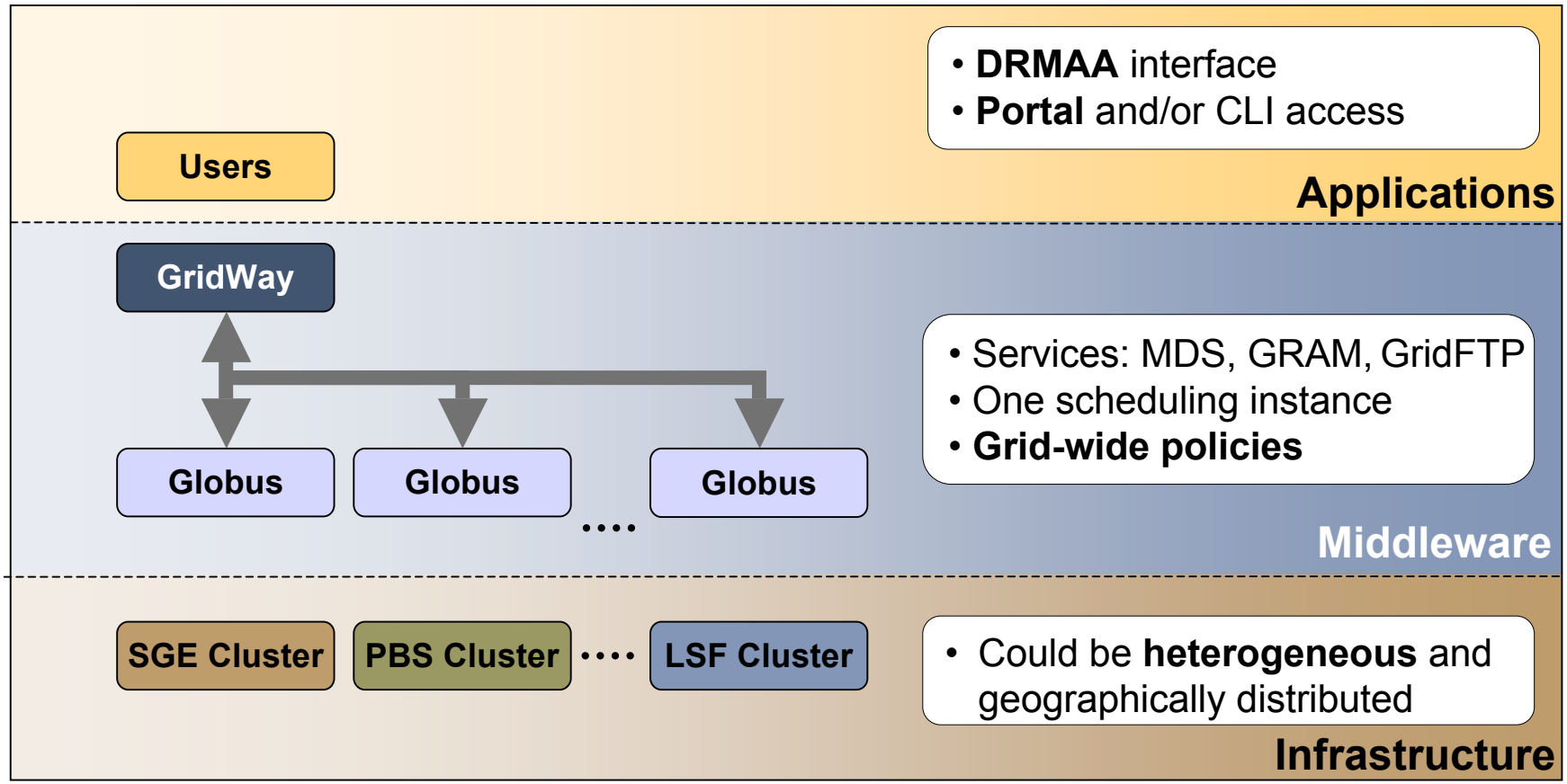
- Integrate multiple systems, that could be heterogeneous, in an *uniform/centralized* infrastructure
- Decoupling of applications and resources
- Improve return of IT investment
- Performance/Usage maximization

Scheduling

- Centralized meta-scheduler that allows the enforcement of **Grid-wide policies** (e.g. resource usage) and provides **centralized accounting**

Scheduling Infrastructures

Enterprise Grids: Deployment with GridWay

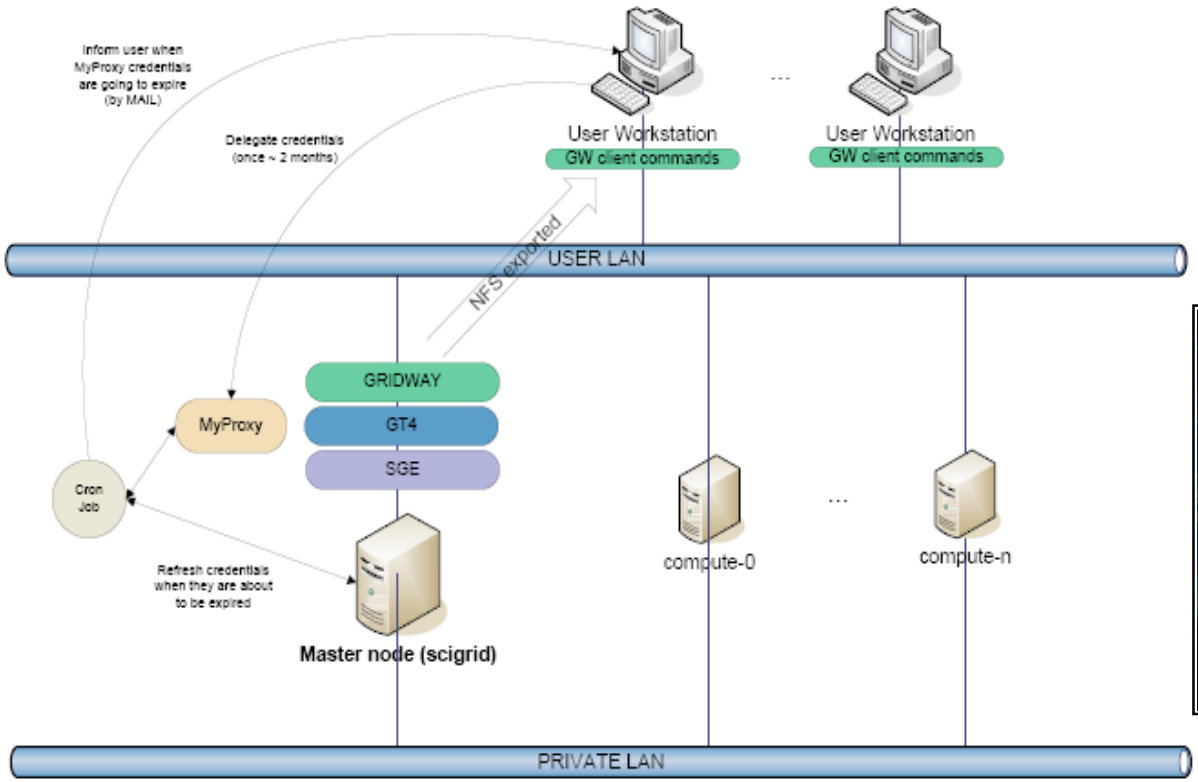


Scheduling Infrastructures

Enterprise Grids: Examples

European Space Astronomy Center

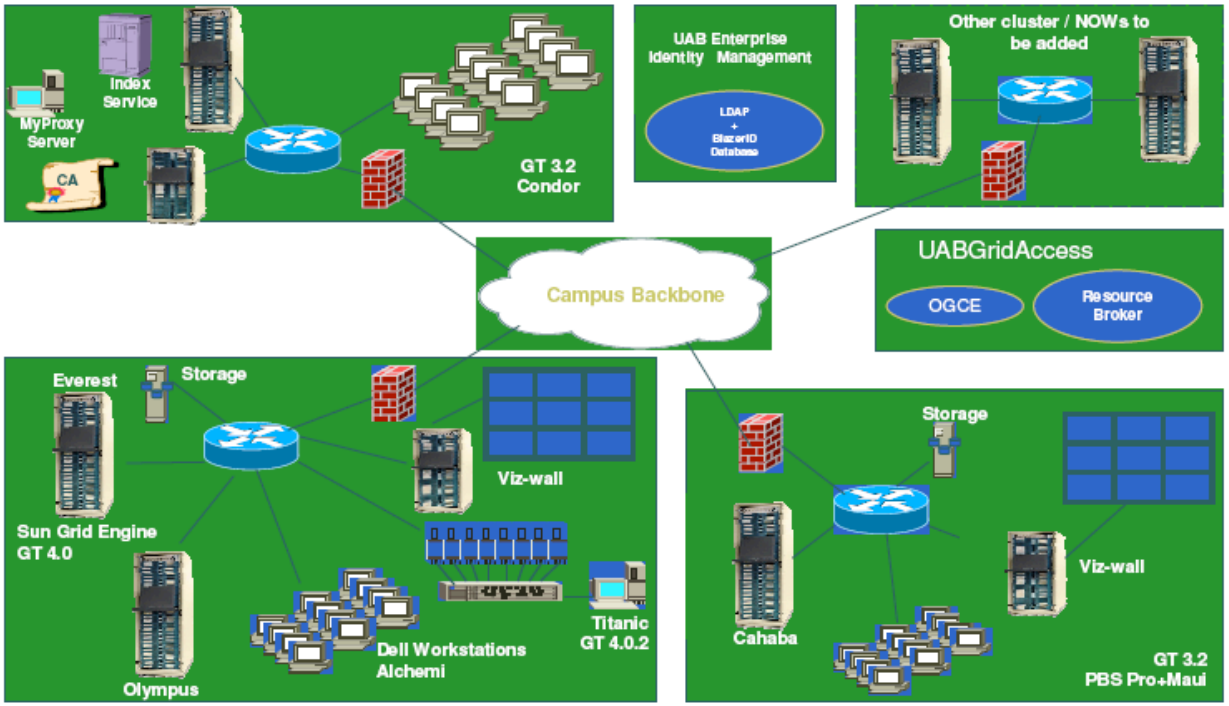
- Data Analysis from space missions (DRMAA)
- Site-level meta-scheduler
- Several clusters



Enterprise Grids: Examples

UABGrid, University of Alabama at Birmingham

- Bioinformatics applications
- Campus-level meta-scheduler
- 3 resources (PBS, SGE and Condor)



Scheduling Infrastructures

Partner Grid Infrastructures

Characteristics

- "Large" scale infrastructures with one or several meta-scheduler instances providing access to resources that belong to different administrative domains (different organizations or partners)

Goal & Benefits

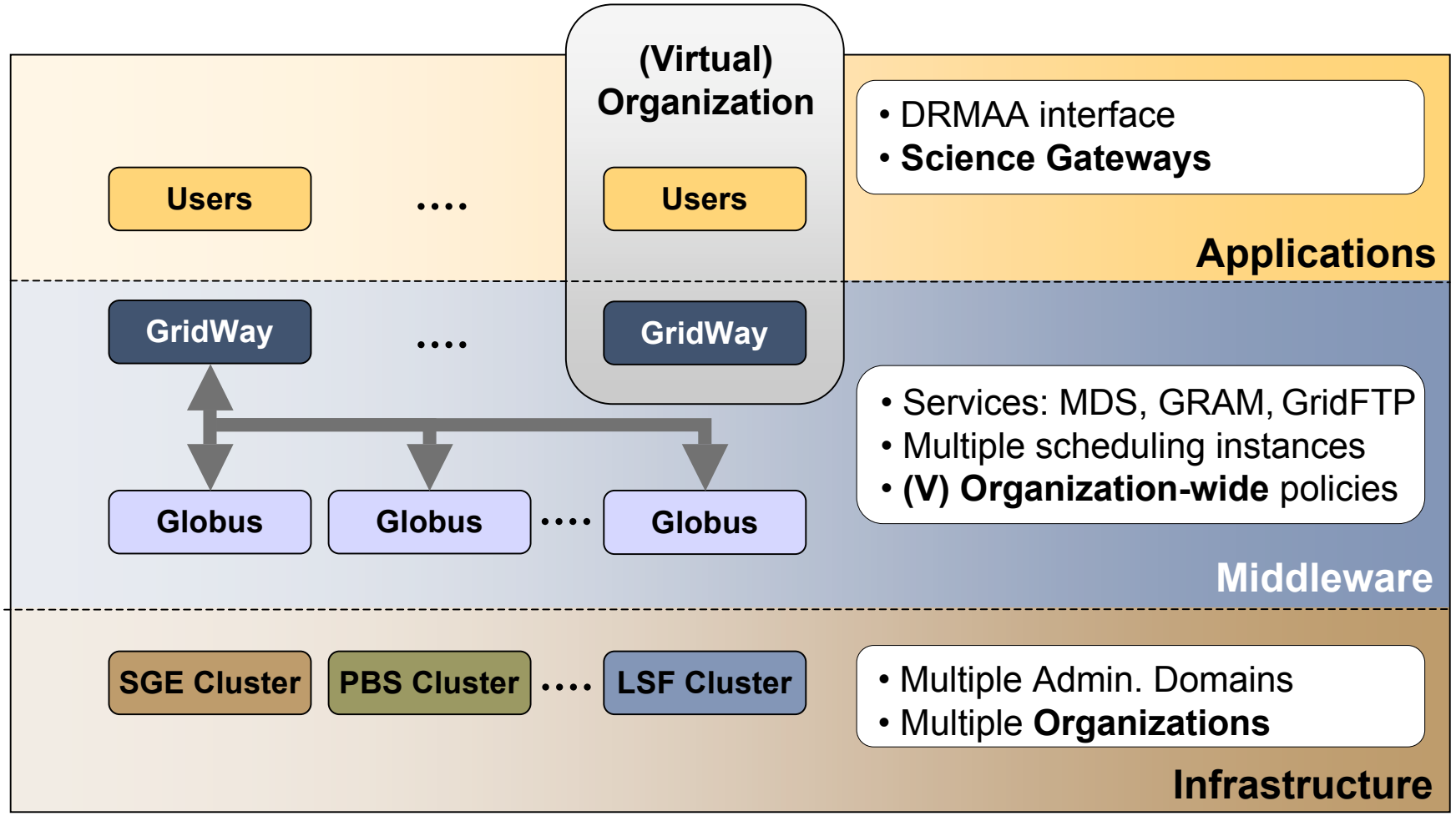
- Large-scale, secure and reliable sharing of resources between partners or supply-chain participants
- Support collaborative projects
- Access to higher computing power to satisfy peak demands

Scheduling

- Decentralized scheduling system that allows the enforcement of **organization-wide** policies

Scheduling Infrastructures

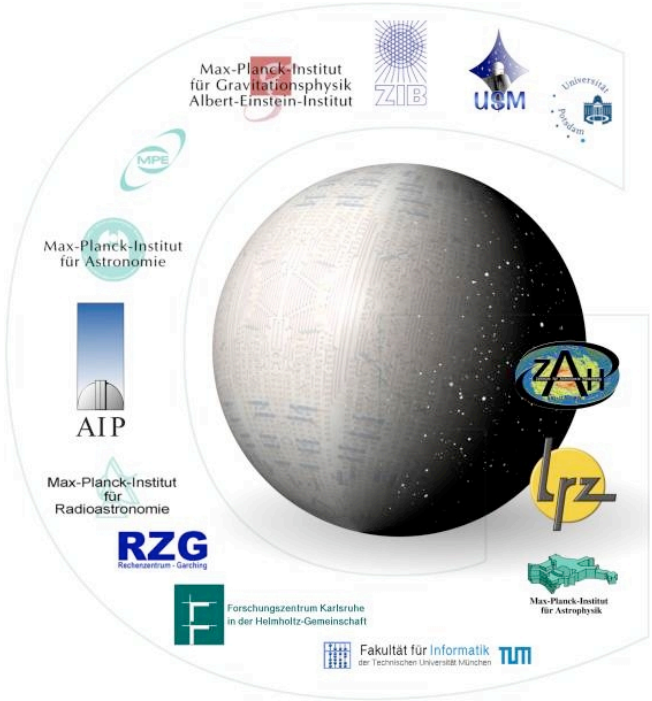
Partner Grids: Deployment with GridWay

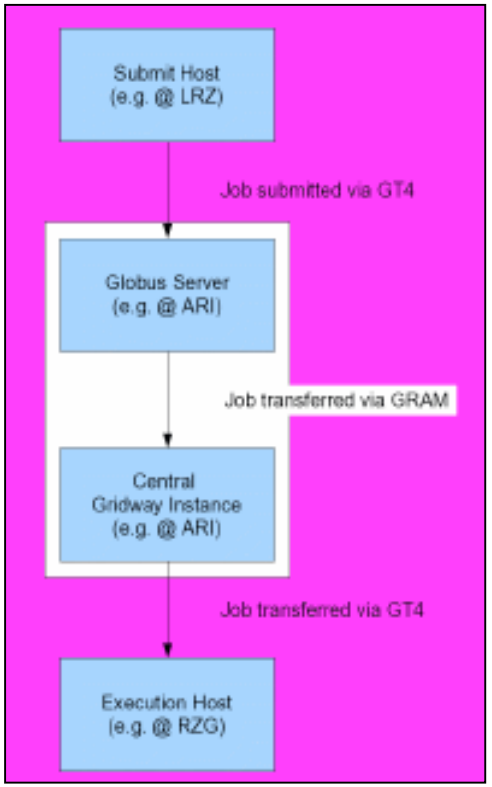


Partner Grids: Examples

AstroGrid-D, German Astronomy Community Grid

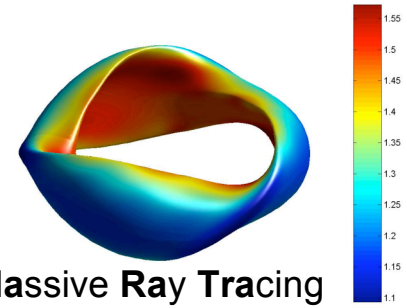
- Collaborative management of supercomputing resources & astronomy-specific resources
- Grid-level meta-scheduler (GRAM interface)
- 22 resources @ 5 sites, 800 CPUs



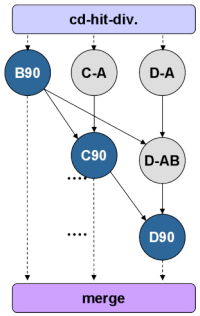


Scheduling Infrastructures

Partner Grids: Examples

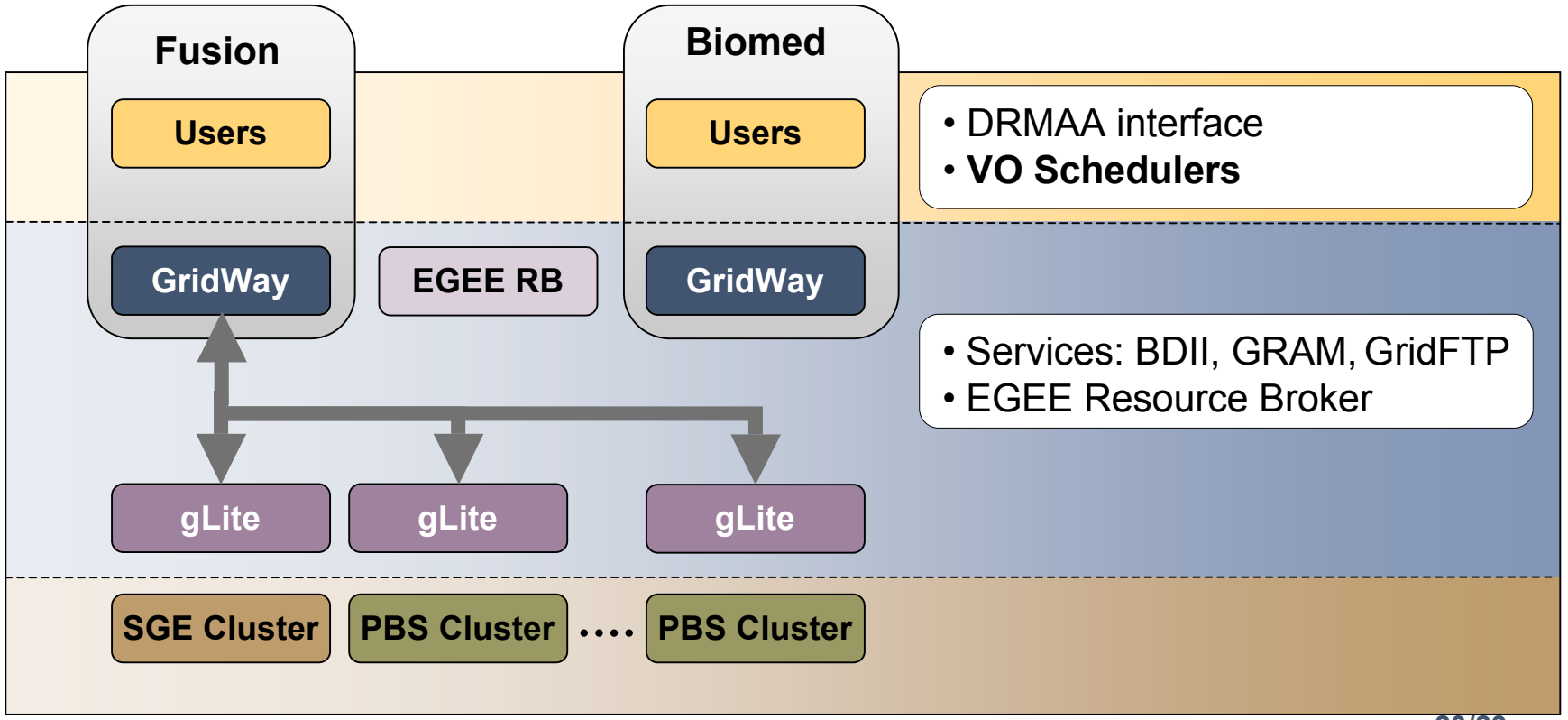


Massive **Ra**y **Tra**cing



CD-HIT workflow

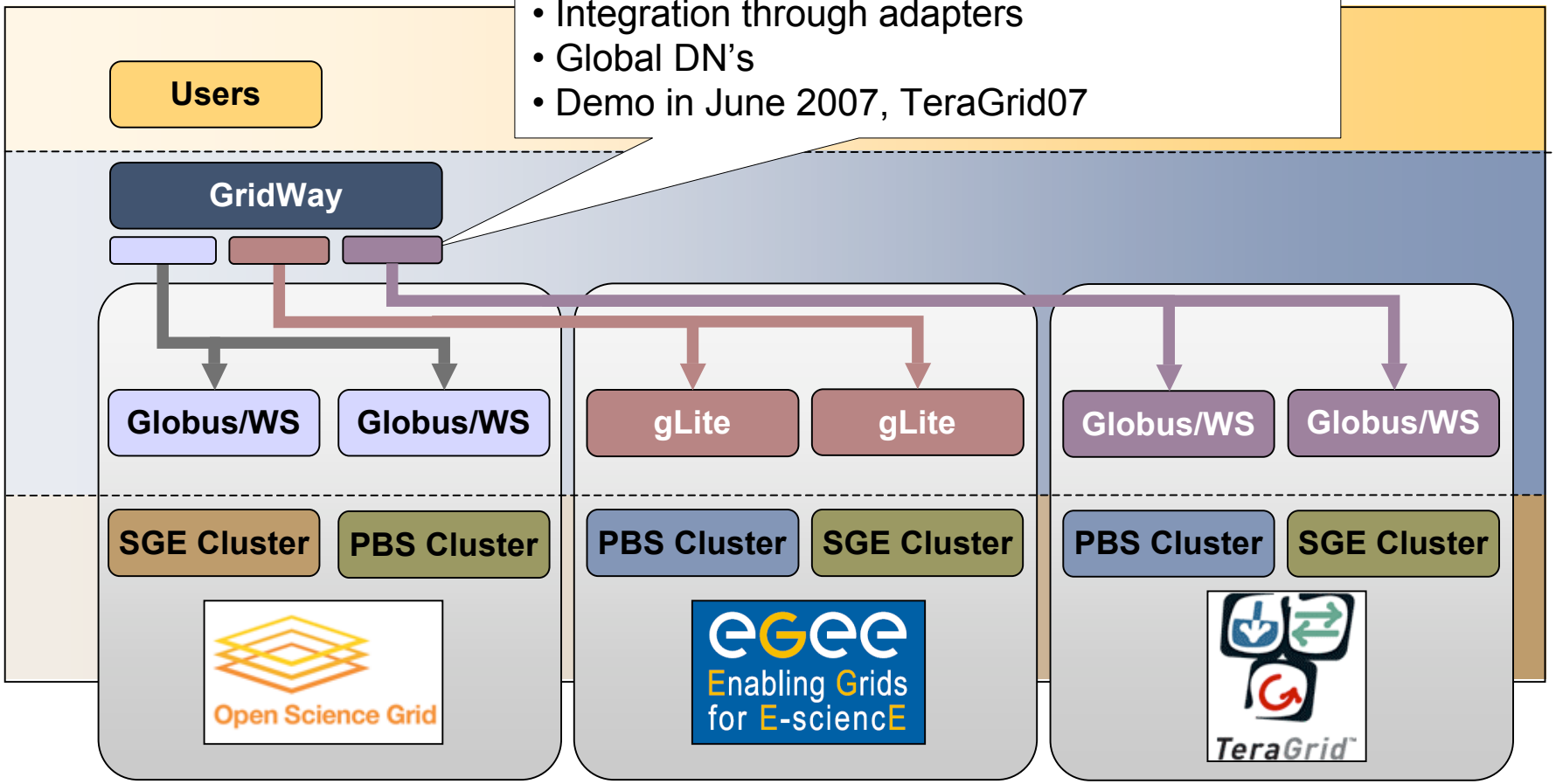
Enabling Grids for E-sciencE



Scheduling Infrastructures

A Tool for Interoperability

- Different Middlewares (e.g. WS and pre-WS)
- Different Data/Execution architectures
- Different Information models
- Integration through adapters
- Global DN's
- Demo in June 2007, TeraGrid07



Scheduling Infrastructures

Utility Grid Infrastructures

Characteristics

- Multiple meta-scheduler layers in a hierarchical structure
- Resource provision in a utility fashion (provider/consumer)

Goal & Benefits

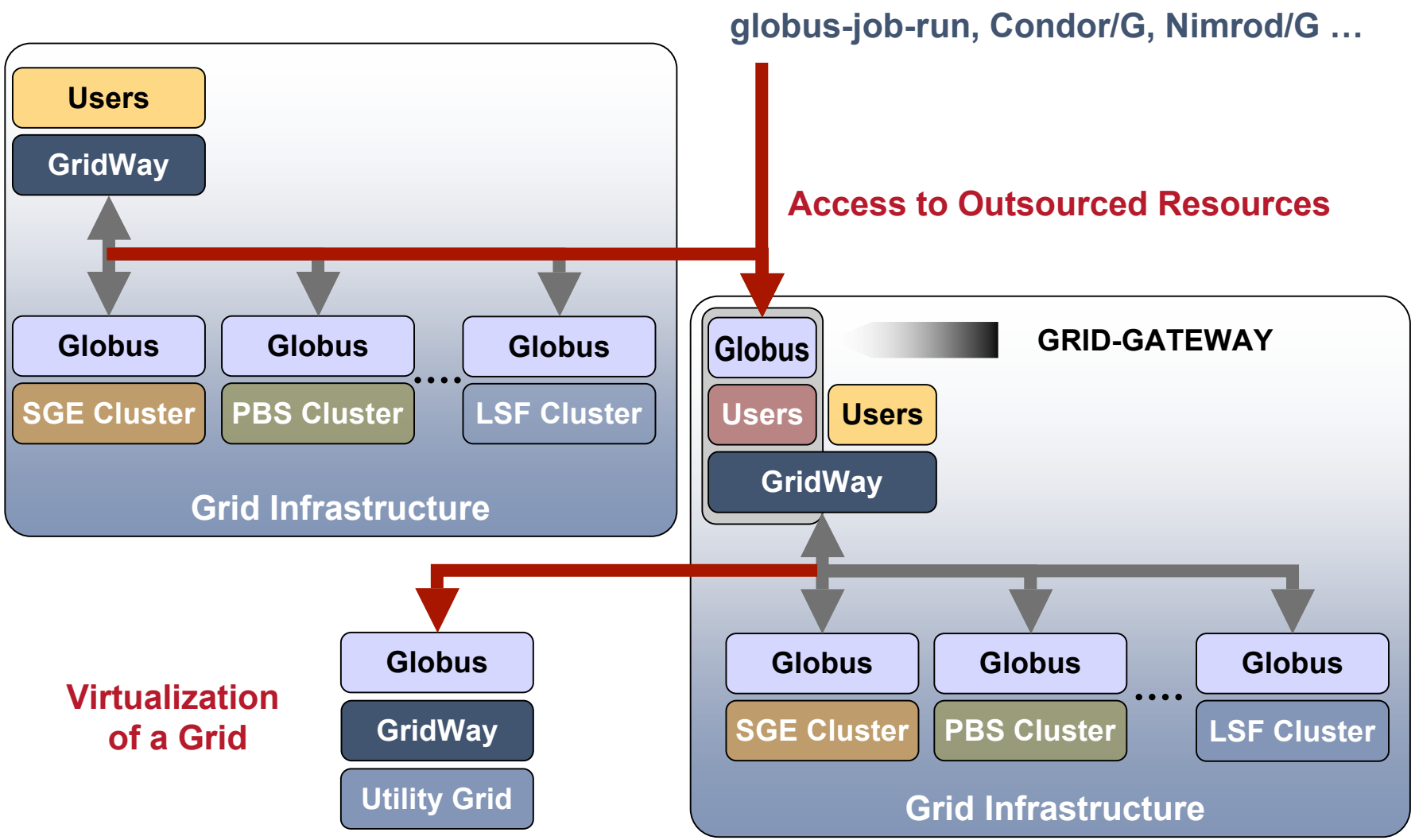
- Supply resources on-demand, making resource provision more adaptive
- Access to *unlimited* computational capacity
- Transform IT costs from fixed to variable
- Seamless integration of different Grids (The Grid)

Scheduling

- Each Grid is handled as any other resource
- Characterization of a Grid as a single resource
- Use standard interfaces to virtualize a Grid infrastructure

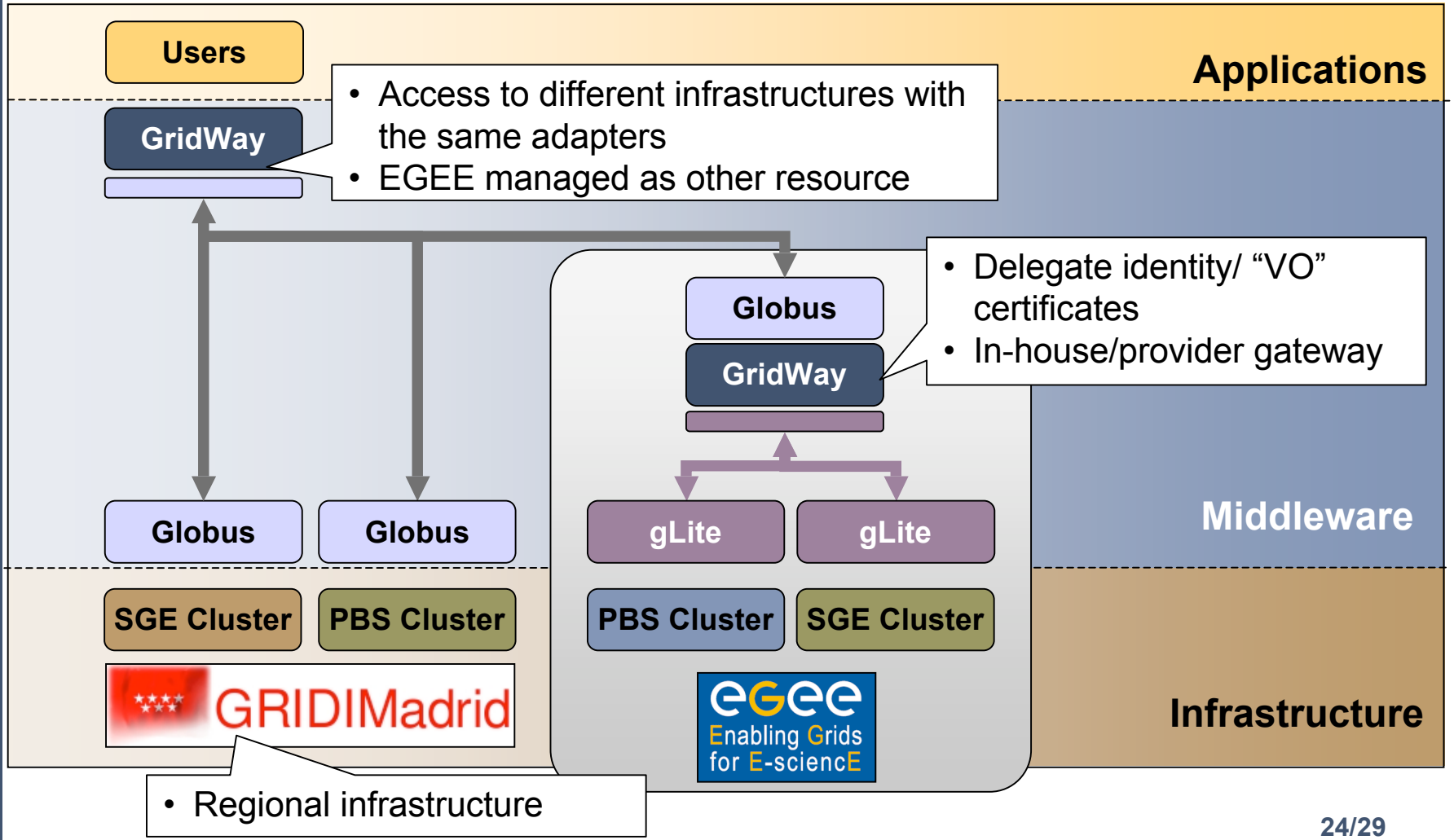
Scheduling Infrastructures

Deploying Utility Grid Infrastructures with GridWay



Scheduling Infrastructures

Utility Grids: Example



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The GridWay Project

Some Projects and Infrastructures

- IRISGrid
- Politecnico di Torino
- CABGrid (Centro de Astrobiología)
- C2VO (Universidad de Castilla La Mancha)
- Grid en ESAC (Agencia Espacial Europea)
- CRO-GRID (Croacia)
- Sun Microsystems Solution Center World Grid
- Infraestructura EGEE
- Proyecto BeinGRID
- GridX1 (Canadian Grid for HEP applications)
- Universidade do Porto
- Madras Institute of Technology
- National Center for High-Performance Computing

Some Application Porting Areas

- Life-Sciences
- Aerospace
- Fusion Physics
- Computational Chemistry

The GridWay Project

History of the Project

- Started in **2002**, first releases were only distributed on request in binary format
- First open source release (v4.0) in **January 2005** (Apache license v2.0)
- Adhering to Globus philosophy and guidelines for **collaborative development**
- In June 2007 GridWay became part of the **Globus Toolkit**
- Since January 2005, more than **1000 downloads from 80 different countries**, 25% are private companies and 75% are universities and research centers.
- Best-effort support provided (contract support is also available)
  - **Based on a strong open source community**

The GridWay Project

Development Process

- **Community –** Open Source Project. Globus Development Philosophy

- **Development Infrastructure** (thanks to Globus Project!)
  - Mailing Lists
  - Bugzilla
  - CVS
- **You are very welcome to contribute:**
  - Reporting Bugs (gridway-user@globus.org)
  - Making feature requests for the next GridWay release (gridway-user@globus.org)
  - Contributing your own developments (bug fixes, new features, documentation)

- Detailed **Roadmap**:
  - **GridWay Campaigns** at bugzilla.mcs.anl.gov/globus/query.cgi
  - www-unix.mcs.anl.gov/~bacon/cgi-bin/big-roadmap.cgi#Gridway

Thank you for your attention!