# An Introduction to Grids and the EELA-2 infrastructure

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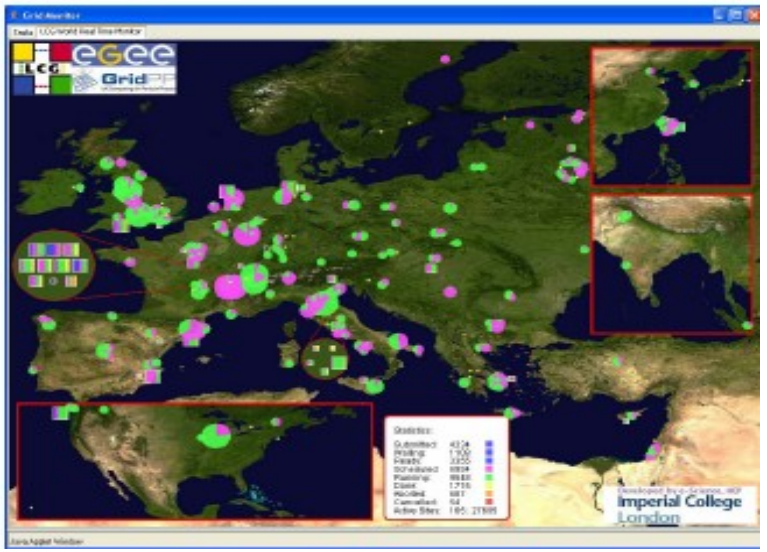
# Outline

- What is a Grid?
- History and Evolution
- Architecture
- Grid Middleware
- Grid Projects
- EELA-2



# Introduction

- Start from the beginning ☺:
  - **What is a grid?**
- Is it a cluster?
- Is it a database?
- Is it a cluster of clusters?
- Is it a collection of databases?
- Is it a collection of machines?
- Several definitions depending on the taste...

# What is a Grid?

# Intro: what is a grid?

- The infrastructure used by utility companies to distribute power to its consumers.
  www.borregosolar.com/resources/glossary.php
- A system of transmission lines which interconnect the generating stations and distribution centres of local electricity authorities.
  www.ergon.com.au/energyed/glossary.asp
- A distribution network, including towers, poles, and wires that a utility uses to deliver electricity.
  www.sunpowercorp.com/homeowners/solar_basics_glossary.html
- A network of power lines or pipelines used to move energy.
  www.windustry.org/resources/glossary.htm

# What is a computational grid?

- Originally used to denote a hardware and software infrastructure that enables applying the resources of many computers to a single problem.
- **Now increasingly used to denote, more broadly, a hardware and software infrastructure that enables coordinated resource sharing within dynamic organizations consisting of individuals, institutions, and resources.**

# Intro: motivation

- Scientific: allow coordinated and organized access to remote resources fostering international scientific collaboration
- Political (my own view): allow coordinated and organized access to non-confidential and confidential data, justify investment on HEP
- Social and technological: helps to fill the digital divide gap

# History and Evolution

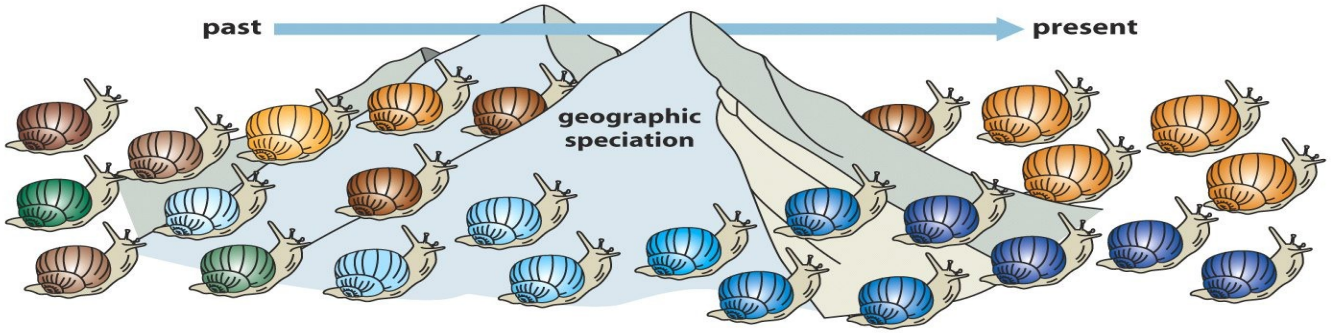


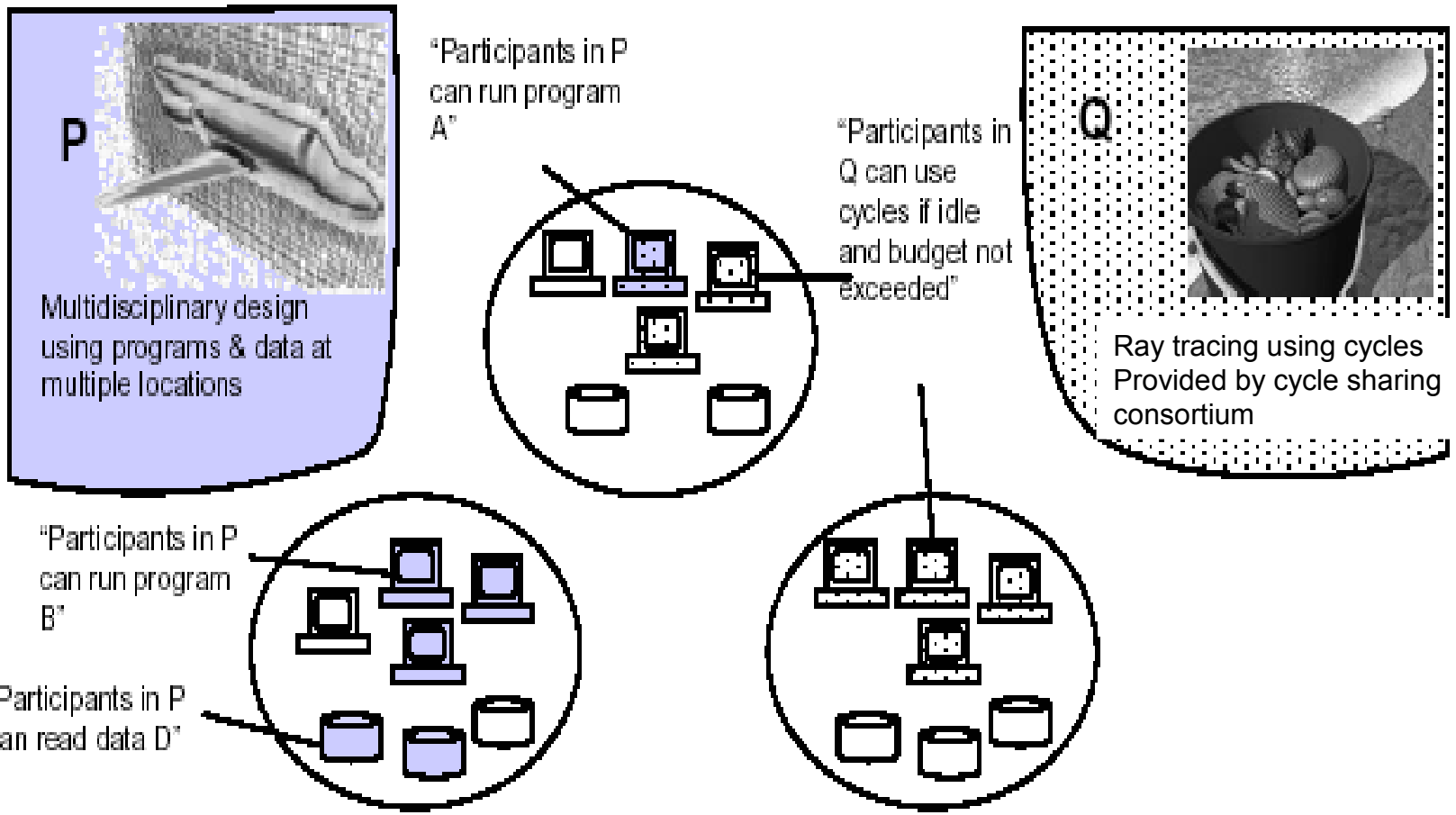

Figure 5-14 Biology Today, 3/e (© 2004 Garland Science)

- Early to mid 90s: numerous research projects on distributed computing
- 1992 (Smarr and Catlett): metasystem
  - a transparent network that will increase the computational and information resources available to an application
- 1995, I-Way
  - IEEE/ACM 1995 Super Computing (San Diego), 11 high speed networks used to connect 17 sites to create one super meta-computer
  - Foster, Nature, 12/2002

- 1996, Globus project started (ANL & USC)
  - Followed I-Way
- 2002, Open Grid Services Architecture (OGSA) was first announced during the Grid Global Forum (now Open Grid Forum)
- Jul 2003: first release of the Globus Toolkit using a service-oriented approach based on OGSA
  - Open Grid Service Infrastructure (OGSI)
- Jan 2004: WS-Resource Framework (WS-RF)
- Apr 2005: Globus Toolkit version 4

- 1993, Legion (Univ of Virginia)
  - Comercial system became AVAKI Sep 2001
- 1997, Unicore (Germany)
- 2000-2006: The Grid Global Forum
- 2006-: Open Grid Forum

# The emergence of virtual organisations




Source: "The Anatomy of the Grid", Foster, Kesselman, Tuecke, 2001

# The Emergence of Virtual Organisations (VO)

- Sharing resources:
  - The degree of service availability – which resources will be shared
  - The authorization of the shared resource – who will be permitted
  - The type of the relationship - Peer to peer
  - A mechanism to understand the nature of the relationship
  - The possible ways the resource will be used (memory, computing power, etc.)

# Architecture

# Grid Architecture

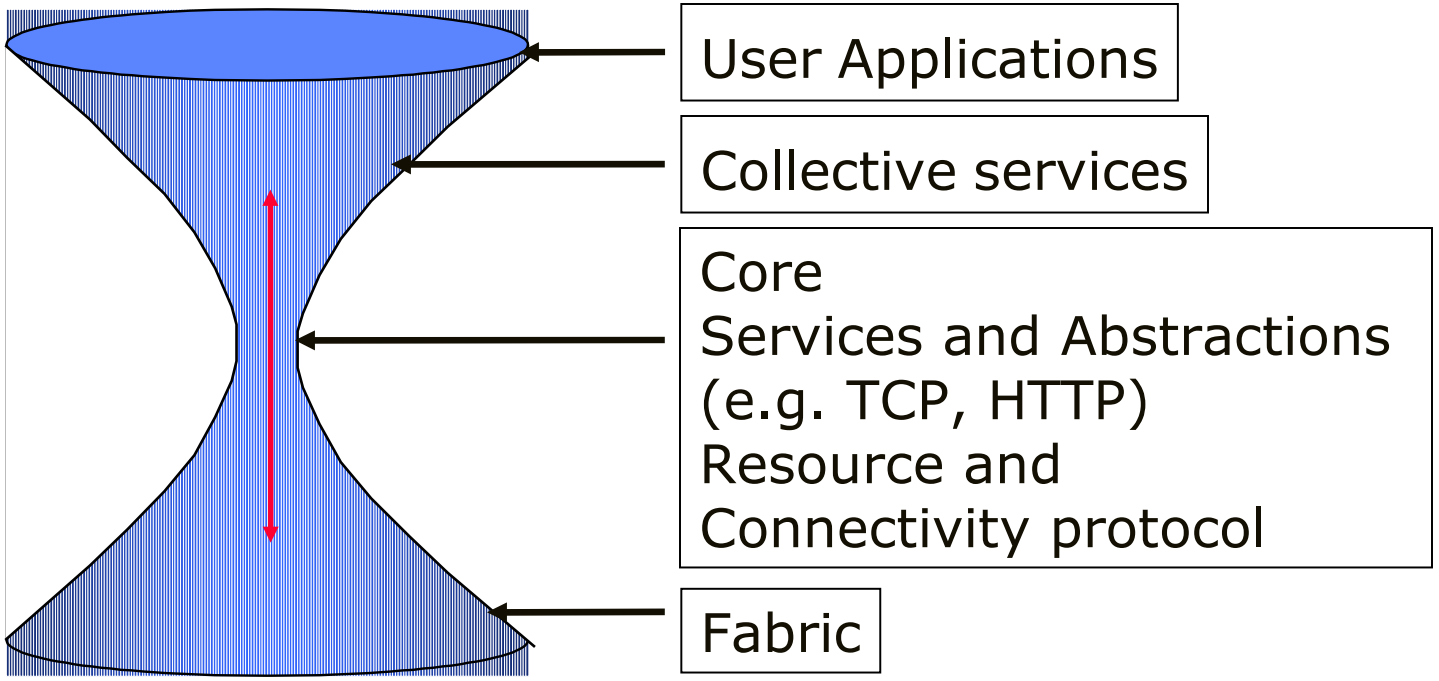
## Requirements

- The components are:
  - numerous
  - owned and managed by different, potentially mutually distrustful organisations and individuals
  - may be potentially faulty
  - have different security requirements and policies
  - heterogeneous
  - connected by heterogeneous, multilevel networks
  - have different resource management policies
  - are likely to be geographically separated

# The Hourglass Model

**Applications**

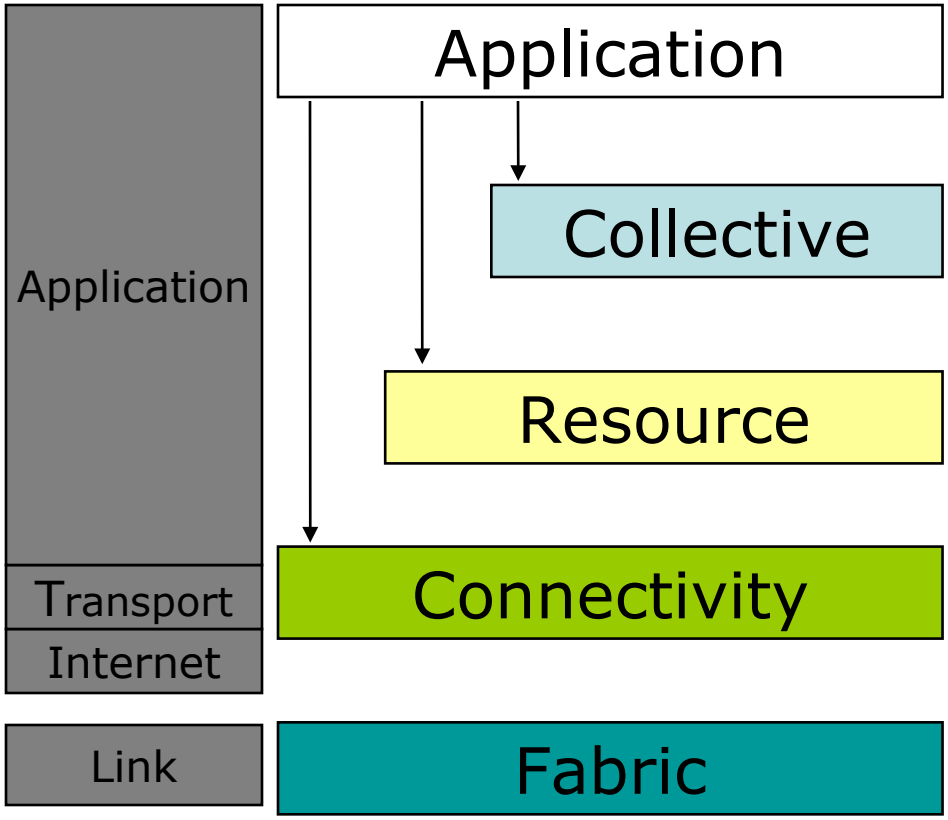
Diverse global services



# Key Components

## Layered Grid Architecture

## (By Analogy to the Internet Architecture)




"Coordinating multiple resources": ubiquitous infrastructure services, app-specific distributed services

"Sharing single resources": negotiating access, controlling use

"Talking to things": communication (Internet protocols) & security

"Controlling things locally": Access to, & control of, resources

# Key Components

## Layered Grid Architecture: Fabric Layer

- Diverse mix of resources that may be shared
  - Individual computers, Condor pools, clusters, file systems, archives, metadata catalogs, networks, sensors, etc.
- Defined by interfaces, not physical characteristics

# Key Components

## Layered Grid Architecture: Fabric Layer

- Communication
  - Internet protocols: IP, DNS, routing, etc.
- Security: Grid Security Infrastructure (GSI)
  - Uniform authentication, authorization, and message protection mechanisms in multi-institutional setting
  - Single sign-on, delegation, identity mapping
  - Public key technology, SSL, X.509, GSS-API
  - Supporting infrastructure: Certificate Authorities, certificate & key management, …

## Layered Grid Architecture: Resource Layer

- The architecture is for the secure negotiation, initiation, monitoring, control, accounting, and payment of sharing operations on individual resources.
- Information Protocols (inform about the structure and state of the resource)
- Management Protocols (negotiate access to a shared resource)

## Layered Grid Architecture: Resource Layer

- Grid Resource Allocation Mgmt (GRAM)
  - Remote allocation, reservation, monitoring, control of compute resources
- GridFTP protocol (FTP extensions)
  - High-performance data access & transport
- Grid Resource Information Service (GRIS)
  - Access to structure & state information
- Network reservation, monitoring, control
- All built on connectivity layer: GSI & IP

GridFTP: www.gridforum.org
GRAM, GRIS: www.globus.org

## Layered Grid Architecture: Collective layer

- Coordinating multiple resources
- Contains protocols and services that capture interactions among a collection of resources
- It supports a variety of sharing behaviours without placing new requirements on the resources being shared
- Sample services: directory services, co-allocation, brokering and scheduling services, data replication services, workload management services, collaboratory services

## Layered Grid Architecture: Collective Layer

- Index servers aka metadirectory services
  - Custom views on dynamic resource collections assembled by a community
- Resource brokers (e.g., Condor Matchmaker)
  - Resource discovery and allocation
- Replica catalogs
- Replication services
- Co-reservation and co-allocation services
- Workflow management services
- Etc.

## Layered Grid Architecture: Applications layer

- There are user applications that operate within the VO environment
- Applications are constructed by calling upon services defined at any layer
- Each of the layers are well defined using protocols, provide access to services
- Well-defined APIs also exist to work with these services

# Grid architecture in practice

| | Multidisciplinary Simulation | Ray Tracing |
|---|---|---|
| Collective (application-specific) | Solver coupler, distributed data archiver | Checkpointing, job management, failover, staging |
| Collective (generic) | Resource discovery, resource brokering, system monitoring, community authorization, certificate revocation | |
| Resource | Access to computation; access to data; access to information about system structure, state, performance. | |
| Connectivity | Communication (IP), service discovery (DNS), authentication, authorization, delegation | |
| Fabric | Storage systems, computers, networks, code repositories, catalogs | |

# Where Are We With Architecture?

- No “official” standards exist
- But:
  - The Globus Toolkit™ has emerged as the de facto standard for several important Connectivity, Resource, and Collective protocols
  - Technical specifications are being developed for architecture elements: e.g., security, data, resource management, information

# Services in the Web and the Grid

## Web services

- Define a technique for describing software components to be accessed, methods for accessing these components, and discovery methods that enable the identification of relevant service providers
- A distributed computing technology (like CORBA, RMI…)
- They allow us to create loosely coupled client/server applications.

# Services in the Web and the Grid

## Web Services: Advantages

- Platform and language independent since they use XML language.
- Most use HTTP for transmitting messages (such as the service request and response)

# Services in the Web and the Grid

## Web Services: Disadvantages

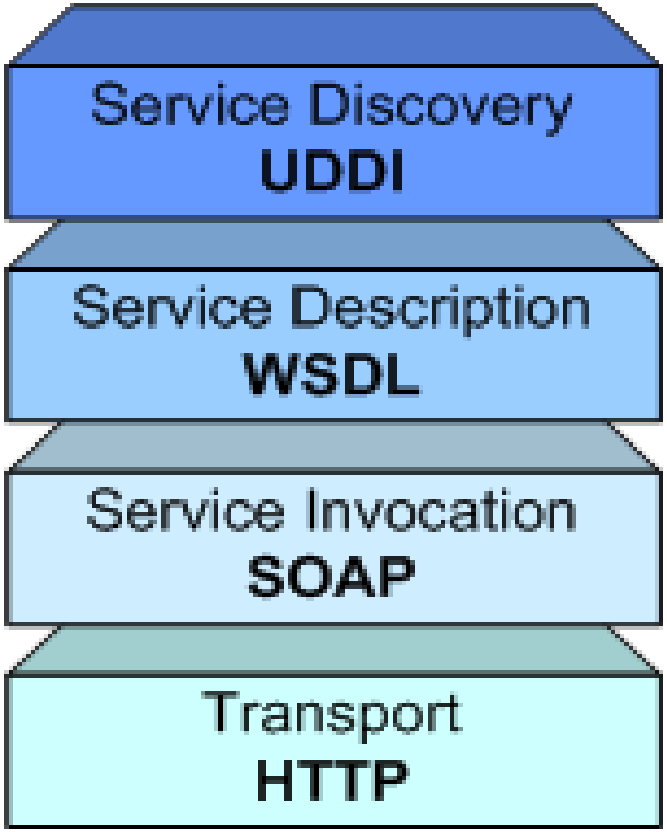
- Overhead : Transmitting data in XML is not as convenient as binary codes.
- Lack of versatility: They allow very basic forms of service invocation (Grid services make up this versatility).
  - Stateless:

    *They can't remember what you have done from one invocation to another*
  - Non-transient:

    *They outlive all their clients.*

# Services in the Web and the Grid

## Web Services Architecture




**Find Web services which meet certain requirements**
***(Universal Description, Discovery and Integration)***

**Services describe their own properties and methods**
***(Web Services Description Language)***

**Format of requests(client) and responses (server)**
***(Simple Object Access Protocol)***

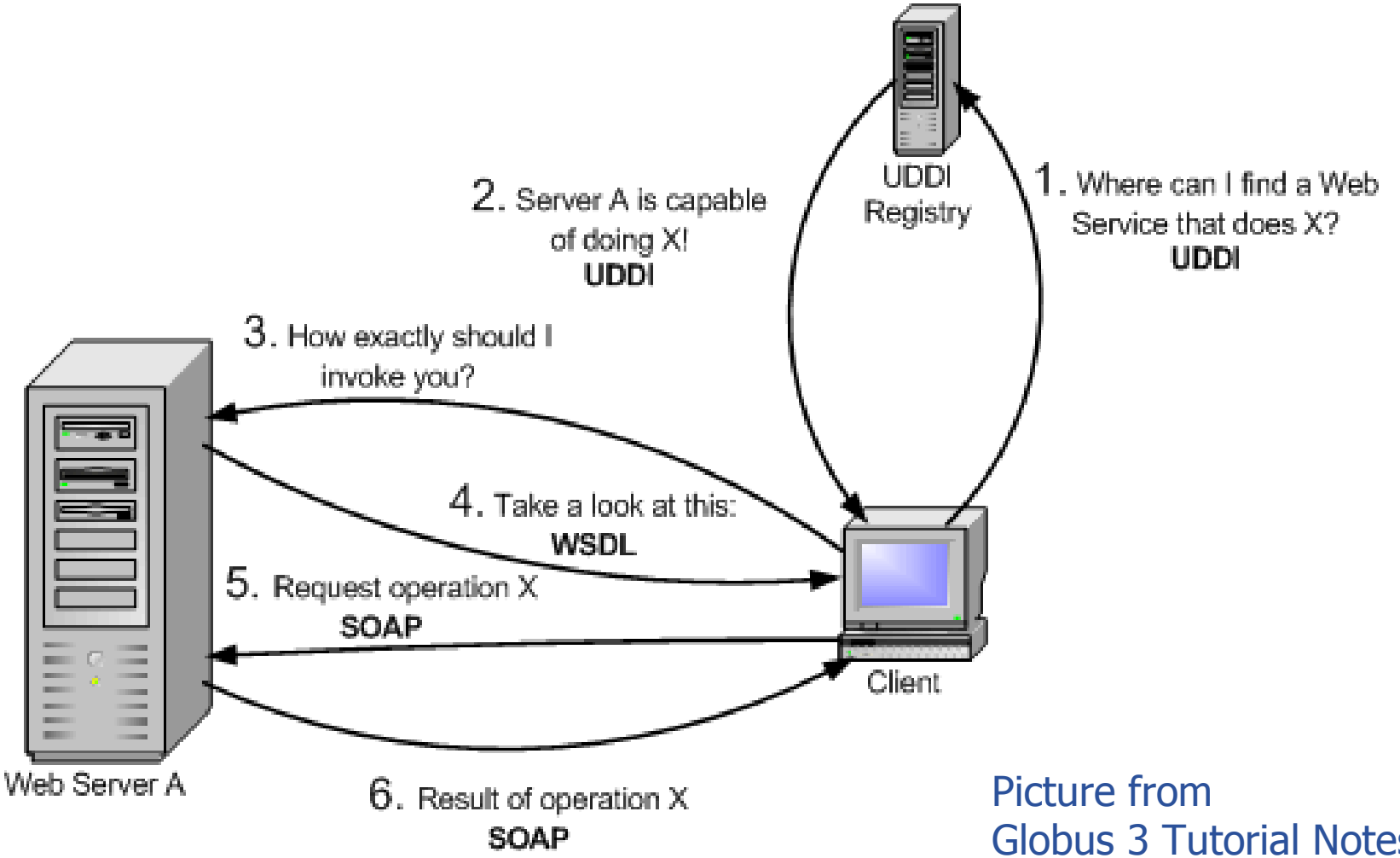
**Message transfer protocol**

***(Hypertext Transfer Protocol)***

Picture from Globus 3 Tutorial Notes www.globus.org

# Services in the Web and the Grid

## Invoking a Typical Web Service




Picture from
Globus 3 Tutorial Notes

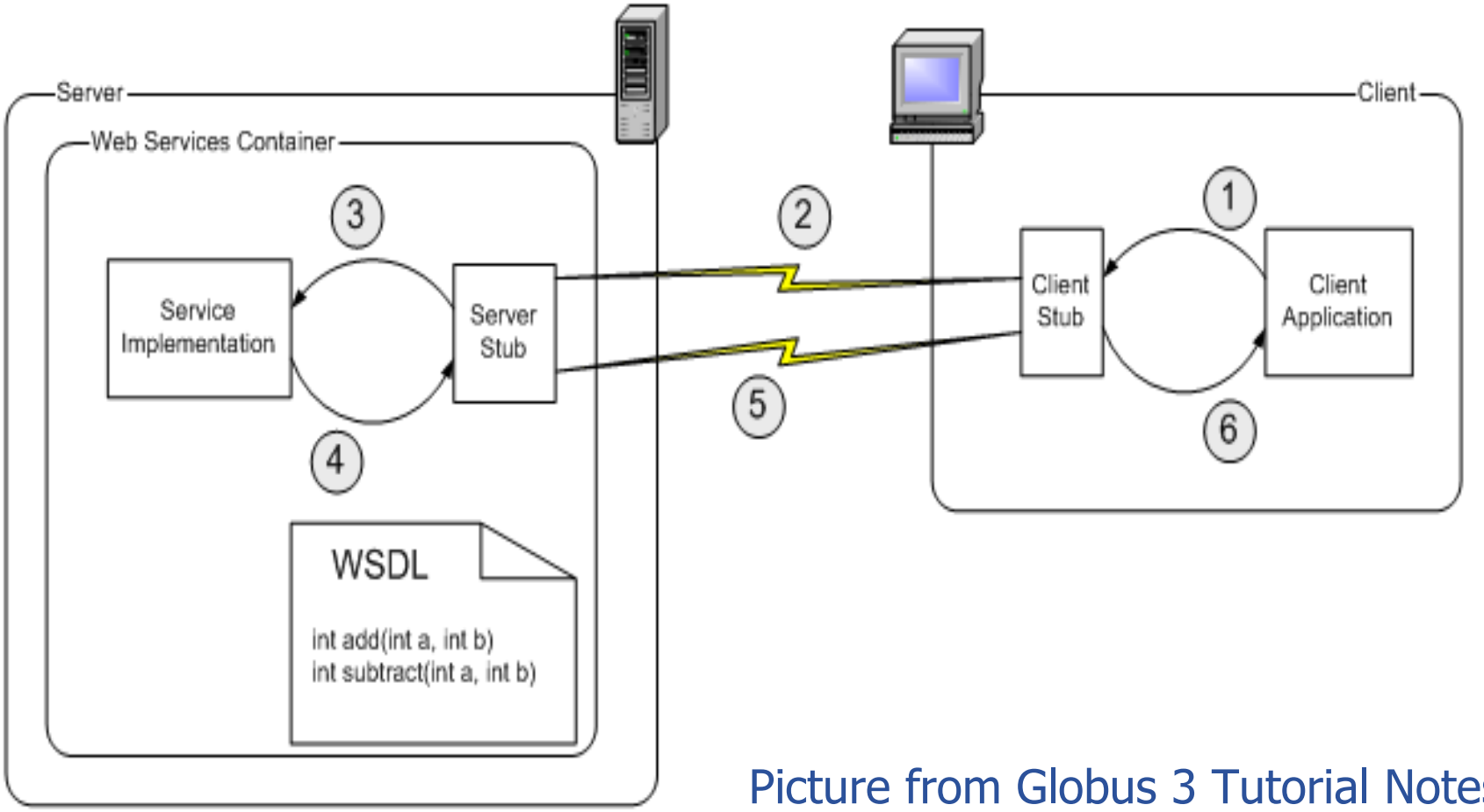
# Services in the Web and the Grid

## Web Service Addressing

- URI: Uniform Resource Identifiers
- URI and URL are practically the same thing.
  - Example: http://webservices.mysite.com/weather/us/WeatherService
- It can not be used with web browsers, it is meant for softwares.

# Services in the Web and the Grid

## Web Service Application

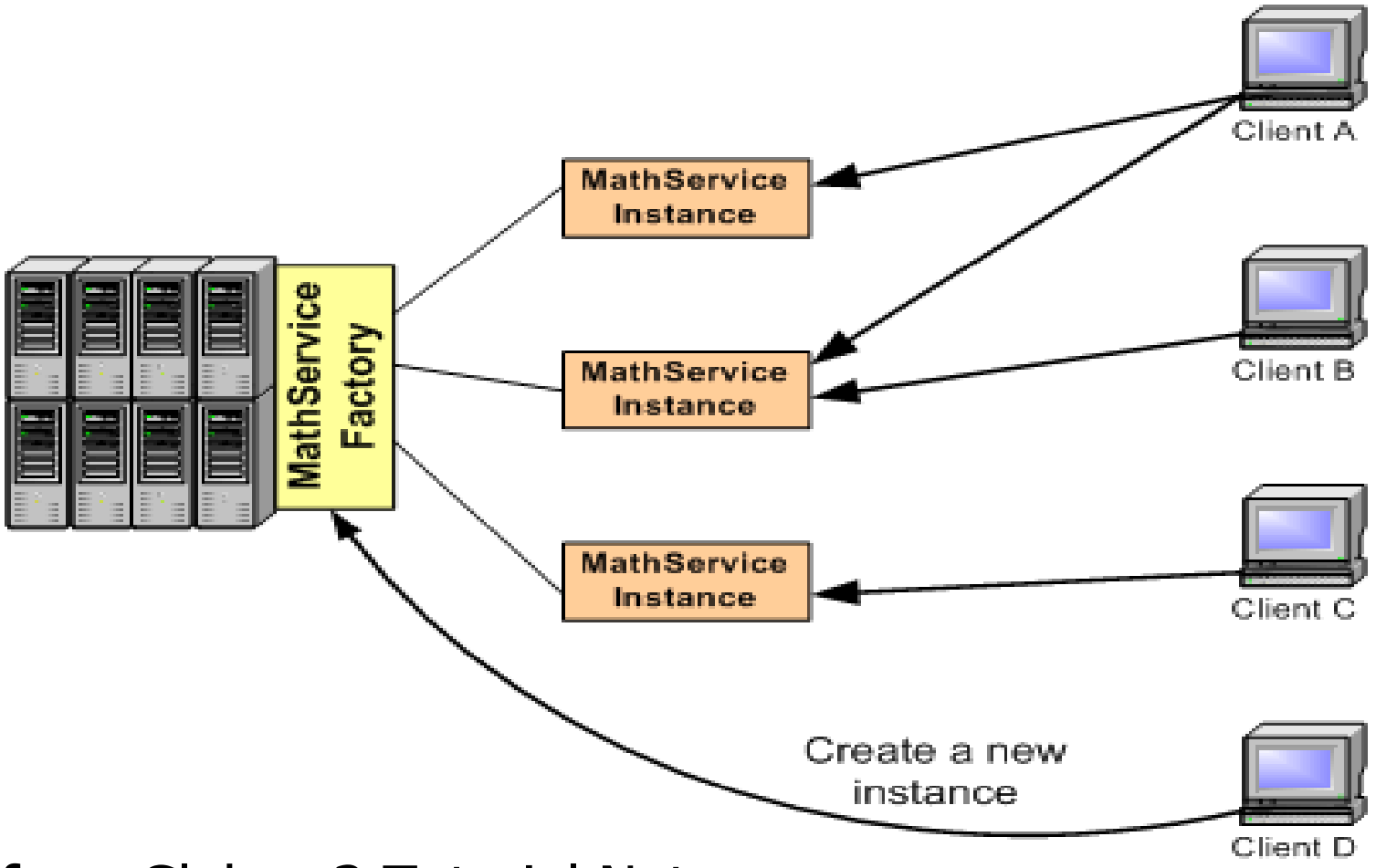



Picture from Globus 3 Tutorial Notes

## What is a Grid Service?

- It provides a set of well defined interfaces that follow specific conventions
- It is a web service with improved characteristics and services:
  - Potentially Transient
  - Stateful
  - Delegation
  - Lifecycle management
  - Service Data
  - Notifications
- *Examples* : computational resources, programs, databases…

## Factories




Picture from Globus 3 Tutorial Notes

# Services in the Web and the Grid
## GSH & GSR

- GSH: Grid Service Handle (URI)
  - Unique
  - Shows the location of the service
- GSR: Grid Service Reference
  - Describes how to communicate with the service
  - When using SOAP, the GSR is a WSDL file.

## Open Grid Services Architecture (OGSA)

- OGSA defines what Grid services are, what they should be capable of, what type of technologies they should be based on.
- OGSA does not give a technical and detailed specification. It uses WSDL.

## Open Grid Services Infrastructure (OGSI)

- It is a formal and technical specification of the concepts described in OGSA.
- The Globus Toolkit 3 is an implementation of OGSI.
- Some other implementations are OGSI::Lite (Perl)1 and the UNICORE OGSA demonstrator2 from the EU GRIP project.
- The OGSI specification defines grid services and builds upon web services.

# Web services and the Grid

## OGSI

- OGSI creates an extension model for WSDL called GWSDL (Grid WSDL). The reason is:
  - Interface inheritance
  - Service Data (for expressing state information)
- Components:
  - Lifecycle
  - State management
  - Service Groups
  - Factory
  - Notification
  - HandleMap

# Services in the Web and the Grid

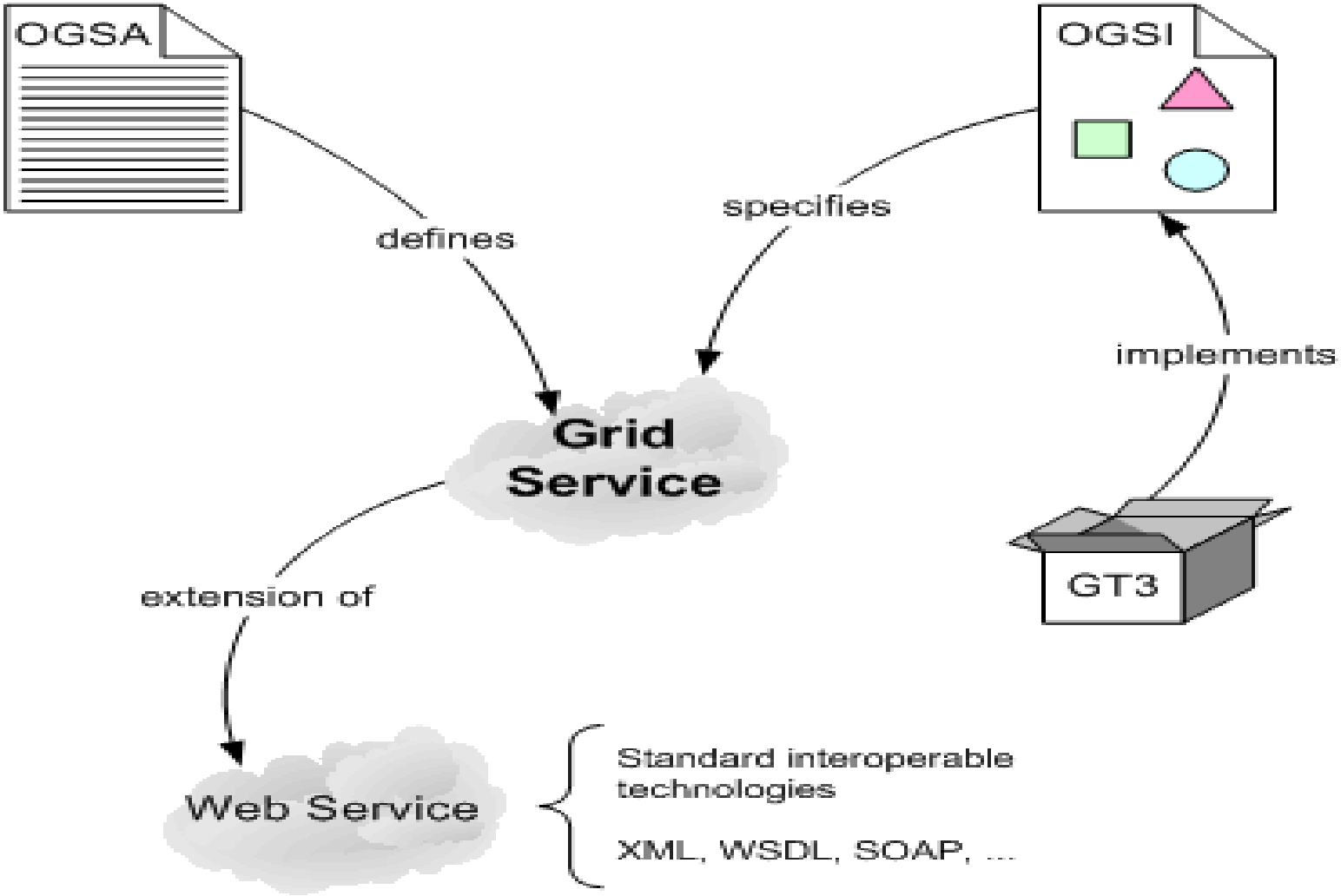
## Service Data Structure

```
<wsdl:definitions xmlns:tns="abc"
   targetNamespace="mynamespace">
  <gwsdl:portType name="AbstractSearchEngine">
   <wsdl:operation name="search" />
    ------------------
   <sd:serviceData name="cachedURL" type="tns:
   cachedURLType"
        mutability="mutable" nilable="true", maxOccurs="1"
   minOccurs="0"
        modifiable="true"/>
  </gwsdl:portType>
</wsdl:definitions>
```

# Web services and the Grid

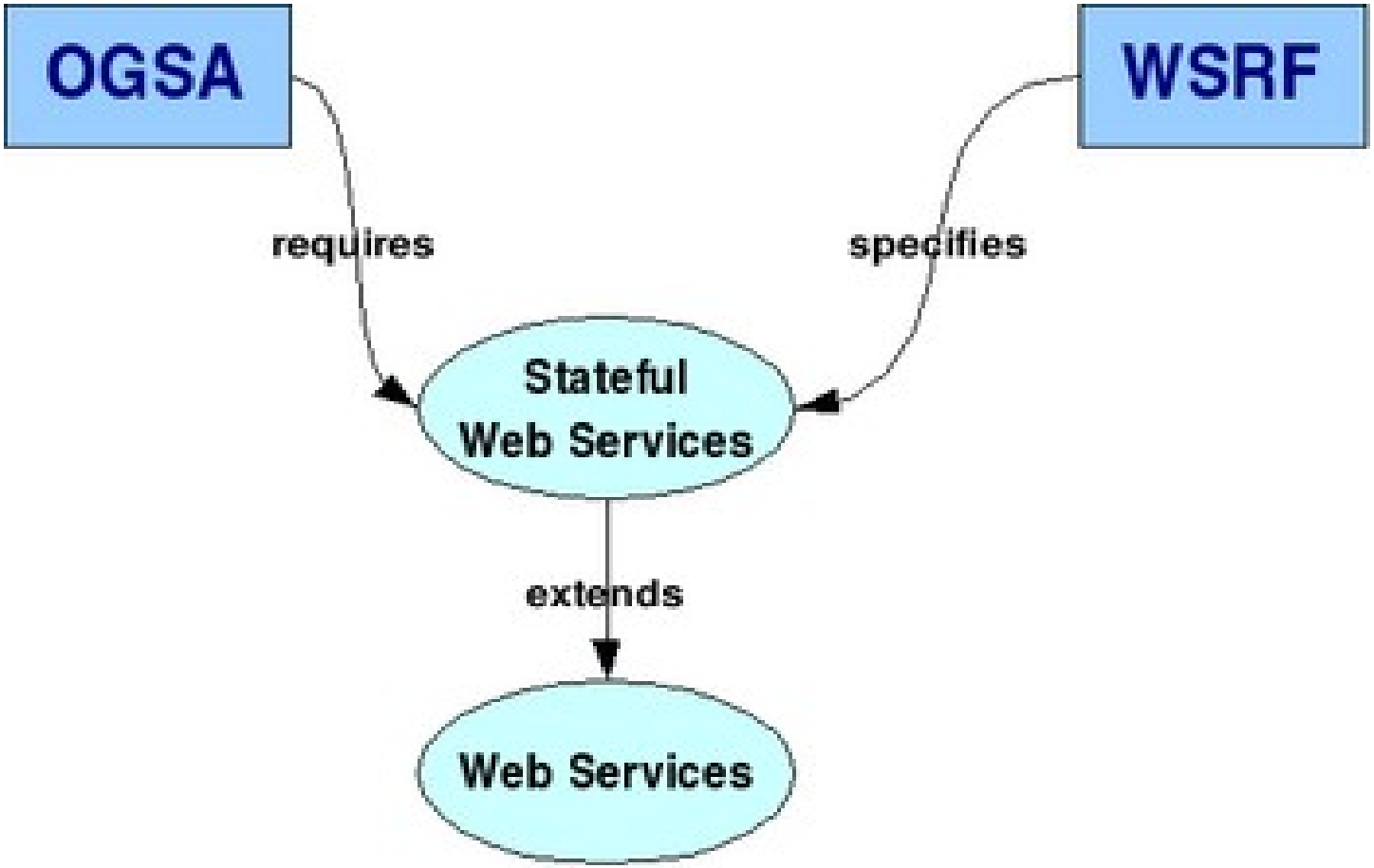
Picture from the Globus 3 Tutorial Notes

## OGSA, OGSI, GT3



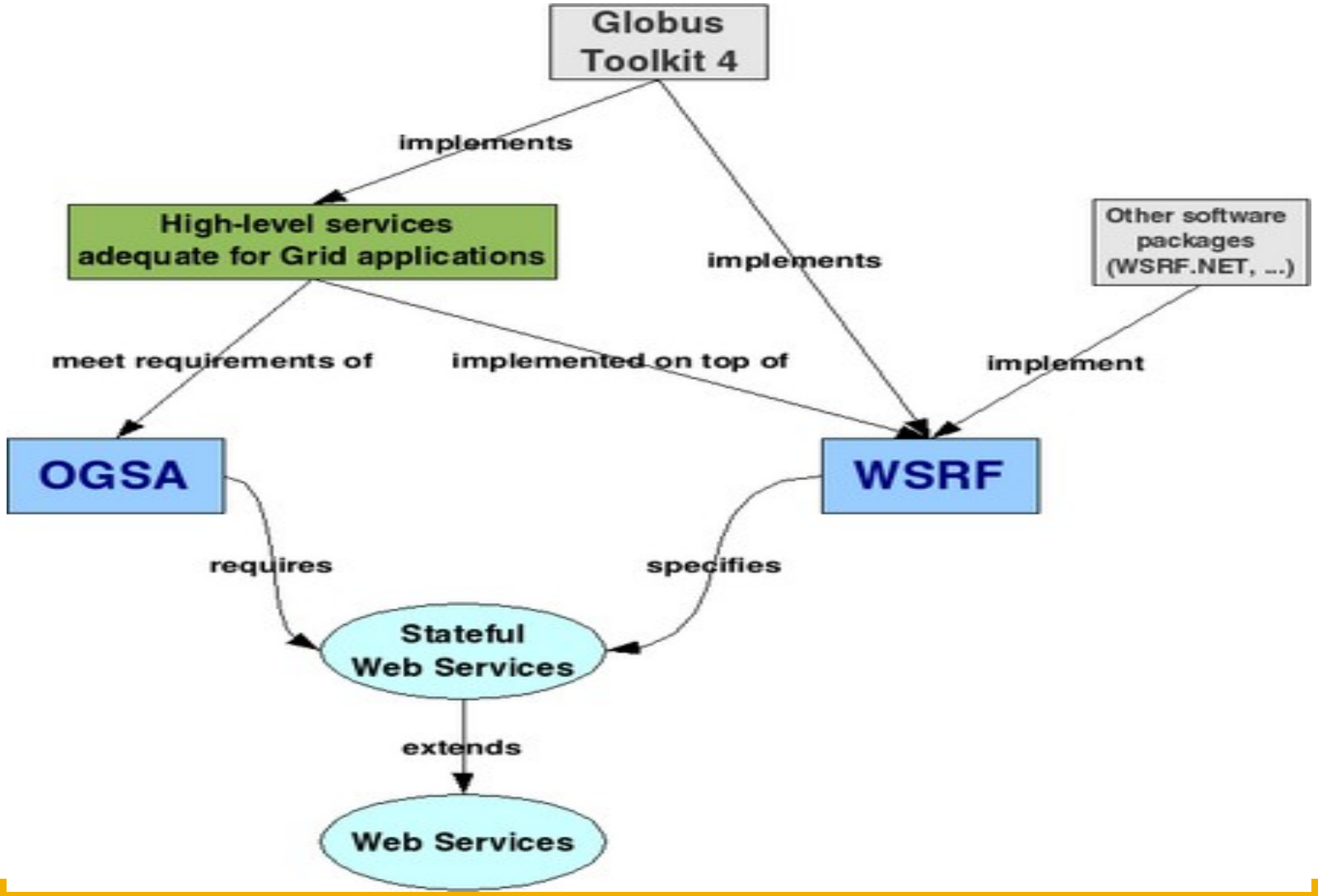
# Web services and the Grid

## OGSA, WSRF, GT4



# Web services and the Grid

## OGSA, WSRF, GT4



# Web services and the Grid

- GT4 replaced OGSI by WSRF (Web Service Resource Framework)
- Framework developed as a joint effort of WS and Grid groups

# Technologies
## Globus

- Goals
- Layered Architecture
- Globus Services
- Limitations

# Technologies
## Goals

- Low-level toolkit providing basic mechanisms such as communication, authentication, network information, and data access
- Long term goal – build an Adaptive Wide Area Resource Environment (AWARE)
- Not intended for application use, instead used to construct higher-level components

# Technologies
## Core Globus Services

- Communication Infrastructure (Nexus)
- Information Services  (MDS)
- Remote File and Executable Management (GASS, RIO, and GEM)
- Resource Management (GRAM)
- Security (GSS)

# Technologies
## Communications (Nexus)

- 5 basic abstractions
  - Nodes
  - Contexts (Address spaces)
  - Threads
  - Communication links
  - Remote service requests
- Startpoints and Endpoints

# Technologies
## Information Services
(Metacomputing Directory Service - MDS)

- Required information
  - Configuration details about resources
    - Amount of memory
    - CPU speed
  - Performance information
    - Network latency
    - CPU load
  - Application specific information
    - Memory requirements

# Technologies

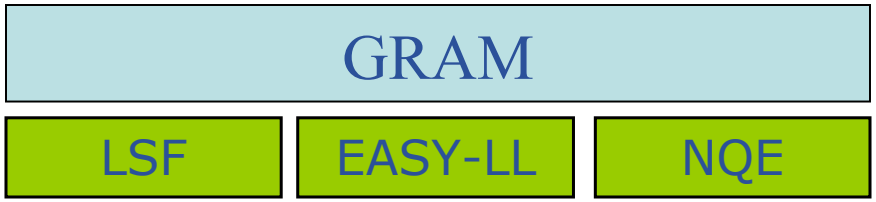
## Remote file and executable management

- Global Access to Secondary Storage (GASS)
  - basic access to remote files, operations supported include remote read, remote write and append
- Remote I/O (RIO)
  - implements a distributed implementation of the MPI-IO, parallel I/O API
- Globus Executable Management (GEM)
  - enables loading and executing a remote file through the GRAM resource manager

# Technologies

## Resource management

- Resource Specification Language (RSL)
  - provides a method for exchanging information about resource requirements between all of the components in the Globus resource management architecture
- Globus Resource Allocation Manager (GRAM)
  - provides a standardized interface to all of the various local resource management tools that a site might have in place




- DUROC
  - provides a co-allocation service
  - it coordinates a single request that may span multiple GRAMs.

# Technologies
## Authentication Model

- Authentication is done on a “user” basis
  - Single authentication step allows access to all grid resources
- No communication of plaintext passwords
- Most sites will use conventional account mechanisms
  - You must have an account on a resource to use that resource

# Technologies
## Grid Security Infrastructure

- Each user has:
  - a Grid user id (called a Subject Name)
  - a private key (like a password)
  - a certificate signed by a Certificate Authority (CA)
- A “gridmap” file at each site specifies grid-id to local-id mapping

# Technologies
## Certificate Based Authentication

- User has a certificate, signed by a trusted "certificate authority" (CA)
  - Certificate contains user name and public key
  - Globus project operates a CA
- User's private key is used to encode a challenge string
- Public key is used to decode the challenge
  - If you can decode it, you know the user

# Technologies

## "Logging" onto the Grid

- To run programs, authenticate to Globus:

  % grid-proxy-init

  Enter PEM pass phrase: ******

- Creates a temporary, short-lived credential for use by our computations

  Private key is not exposed past grid-proxy-init

# Technologies
## Simple job submission

- globus-job-run provides a simple RSH compatible interface

```
% grid-proxy-init
  Enter PEM pass phrase: *****
% globus-job-run host program [args]
```

# Technologies

## Limitations

- Program needs to be compiled on remote machine
- Gatekeepers usually runs as root
- Need to specify filenames as URLs
- Need to specify machine names when executing programs

# Technologies
## Condor

- It is a specialized job and resource management system. It provides:
  - Job management mechanism
  - Scheduling
  - Priority scheme
  - Resource monitoring
  - Resource management

# Technologies

## Condor Terminology

- The user submits a job to an agent.
- The agent is responsible for remembering jobs in persistent storage while finding resources willing to run them.
- Agents and resources advertise themselves to a matchmaker, which is responsible for introducing potentially compatible agents and resources.
- At the agent, a shadow is responsible for providing all the details necessary to execute a job.
- At the resource, a sandbox is responsible for creating a safe execution environment for the job and protecting the resource from any mischief.

# Technologies

## Condor-G: computation management agent for Grid Computing

- Merging of Globus and Condor technologies
- Globus
  - Protocols for secure inter-domain communications
  - Standardized access to remote batch systems
- Condor
  - Job submission and allocation
  - Error recovery
  - Creation of an execution environment

# Grid Middleware



# Grid Middleware

- Unicore
- GOS
- OurGrid
- EasyGrid
- BoinC
- OSG
- gLite
- GridBus Broker



# Grid Projects


# Grid Projects

- TeraGrid
- EGEE
- EuMedGrid
- EuChinaGrid
- EuIndiaGrid
- NAREGI
- DEISA
- EELA-2

# The EELA-2 Project

- EELA and EELA-2
  - www.eu-eela-eu
  - http://indico.eu-eela.eu/conferenceOtherViews.py?view=standard&confId=193
- The EELA-2 model for long-term sustainability
  - http://indico.eu-eela.eu/conferenceOtherViews.py?view=standard&confId=193
- No EELA-3 … but perhaps “CHAIN”

**Kick-off Meeting at CETA-CIEMAT**

# Projects in numbers

## EELA (SSA under FP6)

*E-infrastructure shared between Europe and Latin America*

- EC support: 1.7 M€
- CIEMAT extra support: 0.4 M€
- 10 Countries (3 in Europe)
- 2 International Organisations
- 20 Members (7 in Europe)

**Final review:**

**EELA considered as a**

**"Good to excellent project"**

## EELA-2 (I³ under FP7)

*E-science grid facility for Europe and Latin America*

- EC support: 2.1 M€
- CETA-CIEMAT extra funds: 0.3 M€
- Currently 14 Countries (5 in Europe)
- 1 LA country joining (Uruguay)
- Currently 1 International Organisation
- 1 International Organisation joining
- Currently 47 Members (15 in Europe)
- 31 Institutions joining (1 in Europe)
- Currently 9 JRUs (3 in Europe)
- 3 new JRUs (1 in Europe)

# Countries and Resources Centres

**Soon**

- **Uruguay**
- **Jamaica**

**EELA-2**

- **14 Countries**
- **16 Partners (9 JRUs)**
- **47 Members**

**France**

**Ireland**

Italy

Portugal

Spain

Argentina

Brazil

Chile

Colombia

Cuba

Ecuador

Mexico

Peru

Venezuela

CLARA (International)

# EELA & EELA-2 objectives

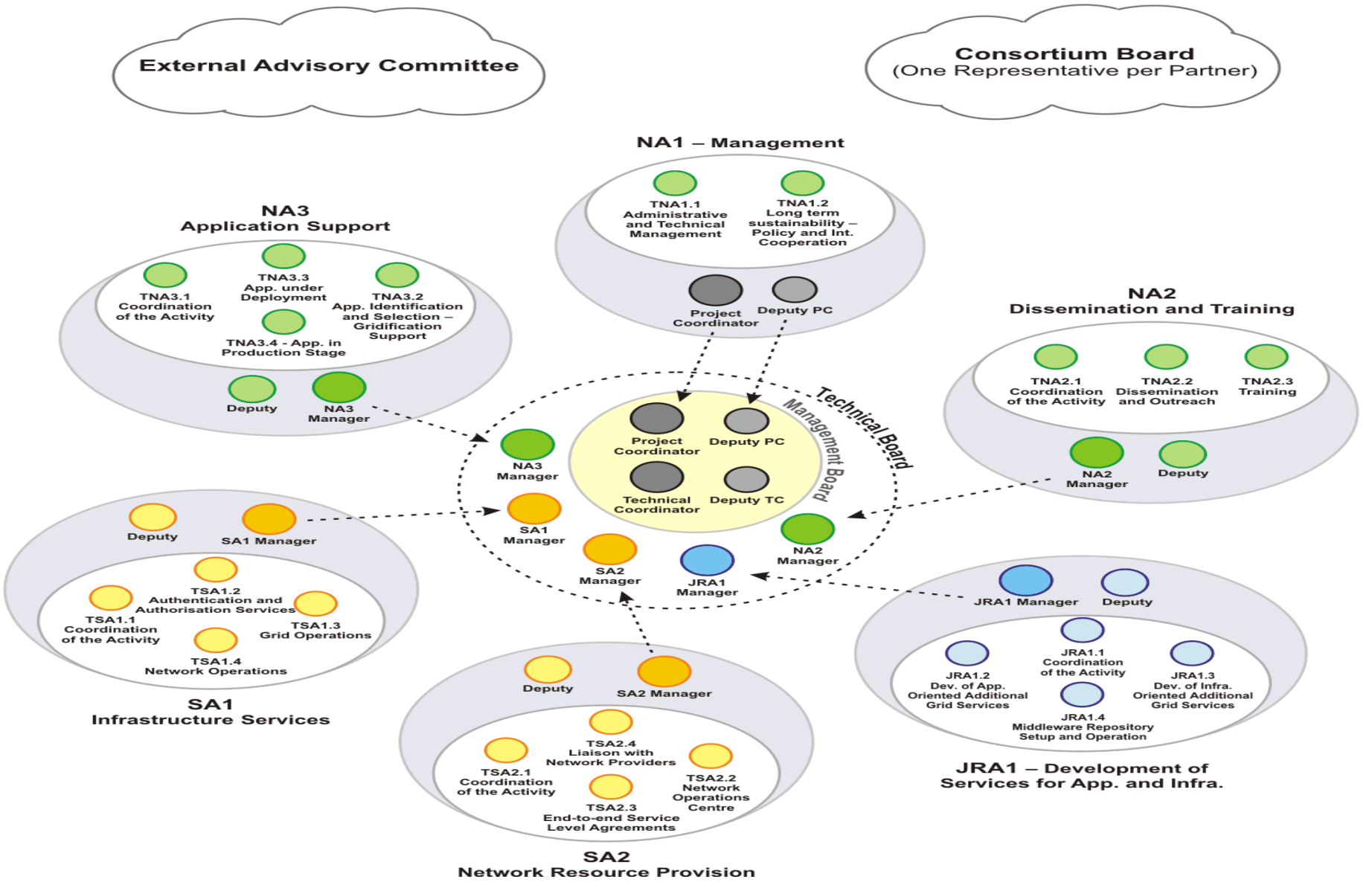
## EELA

- Build a bridge between consolidated e-Infrastructure initiatives in Europe and emerging ones in Latin American
- Create a collaboration network to deploy a large portfolio of scientific applications on a well supported Pilot Test-bed
- Care in parallel of the training in grid technologies and of the knowledge dissemination and outreach

## EELA-2

- Provide an empowered Grid Facility with versatile services fulfilling application requirements
- Ensure production quality services
- Ensure the long term sustainability of the e-Infrastructure beyond the term of the project
- Expand the current EELA e-Infrastructure
- Look for new communities outside academia (Industry and Business)

# EELA-2 organisation



# More Numbers

## EELA

### At the end of the Project

See http://documents.eu-eela.org/record/955/files/

- # Sites: 19 (13 in Production)
- # Cores: 2700
- Storage: 100 TB
- # Jobs: 430,000
- Scientific domains: 4
- # Applications: 18
  - 12 in production
  - 6 gridified
- Conferences: 3
- Workshops: 8
- Tutorials: 18
- Trained people: 733
- Grid Schools: 2

## EELA-2

### After 1 year

see http://documents.eu-eela

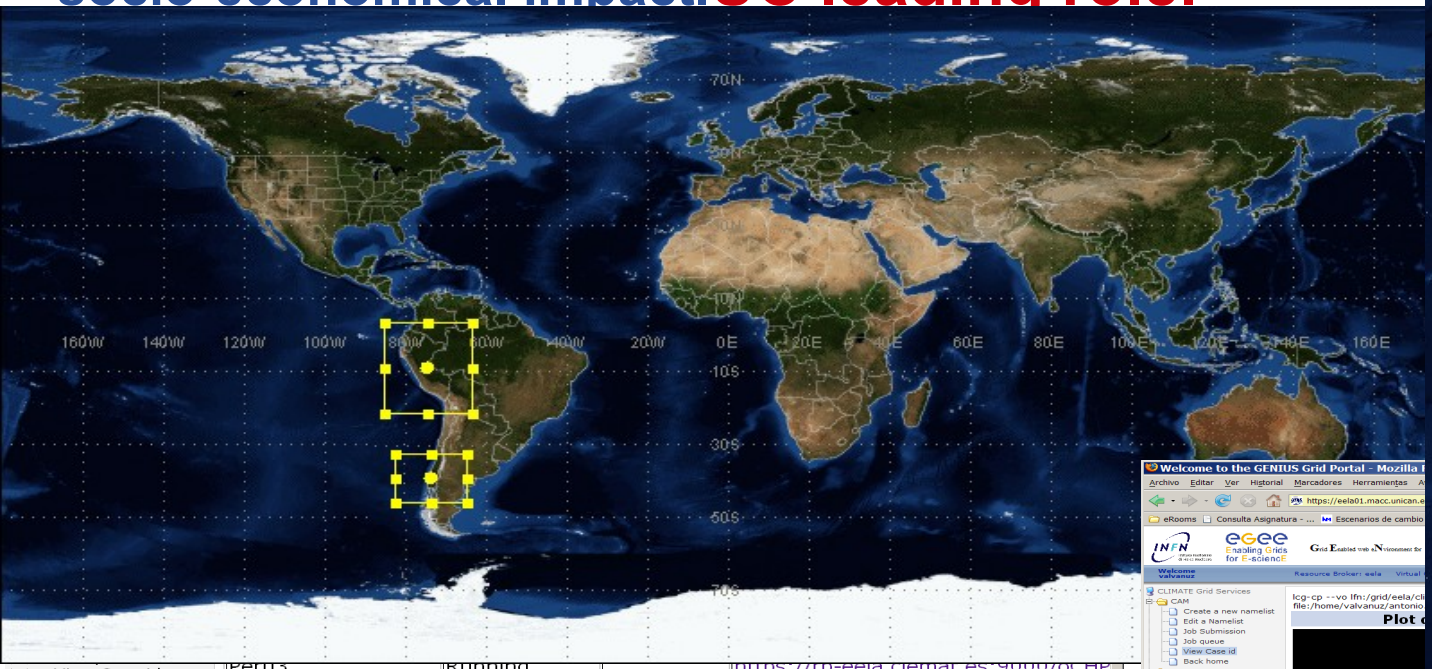
- # Sites: 22
- # Cores: ≈ 5800
- Storage: ≈ 192 TB
- # Jobs : ≈ 1,000,000
- Scientific domains: 9
- # Applications: 55
  - 12 in production
  - 15 Gridified
- Conferences: 1
- Workshops: 4
- Tutorials: 8
- Trained people: 158
- Grid Schools: 1

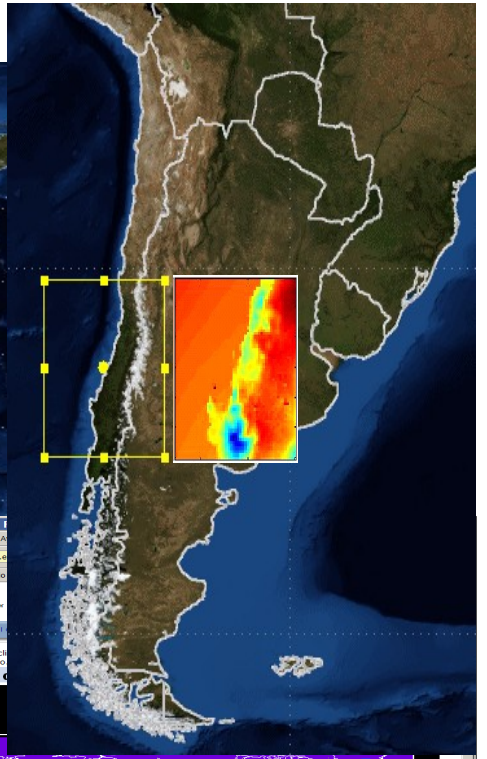
- **Problem Addressed**
  - WISDOM (Wide In-Silico Docking Of Malaria) is a deployment of a *high-throughput virtual screening platform* in the perspective of *in-silico drug discovery* for *neglected diseases*
  - The in-silico docking is faster and much cheaper than the experimental docking, which is restricted to the most successful ligands obtained after the simulation process

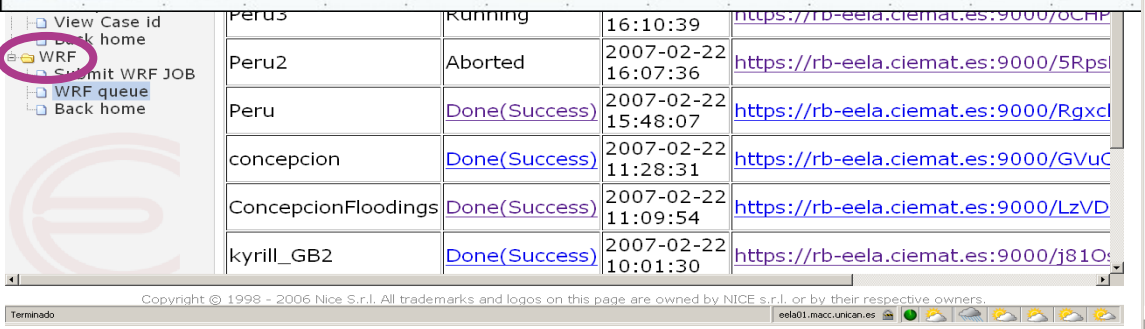
- **UPV important role (Data Challenge)**
- **Latin American Interest**
  - Collaboration is started in the analysis of new targets for malaria. New targets of Plasmodium Vivax have been included in large-scale docking experiments

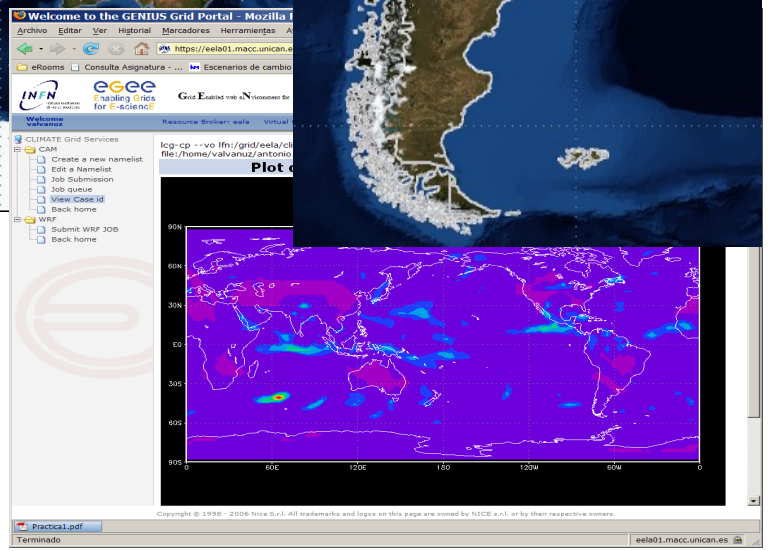
# EELA success stories: another example

**Goal: Predict Local Impacts of "El Niño" and "La Niña" in Latin America. A challenging problem for the climate community with huge socio-economical impact.** **UC leading role.**





# The Bogotá conference

http://agamenon.uniandes.edu.co/~comit/wikieela2/doku.php?id=start

- About 380 registrants (266 from Colombia)
- Conference Themes
  - Grid Communities and Applications
  - e-Infrastructures case studies
  - e-Infrastructures for Development
- Contributions
  - 63 abstracts received
    - 36 Oral presentations (12 from Spain and Portugal)
    - 20 Posters
  - 7 Invited talks
  - 1 panel on long term sustainability of e-Infrastructures in Latin America
- EELA-2 model for long-term sustainability
  - Very well accepted by the audience (including Decision Makers)
  - Very well supported by the President of CLARA
- Presentations available at

http://indico.eu-eela.eu/conferenceOtherViews.py?view=standard&confId=132

**Part of the audience at the Closing session**

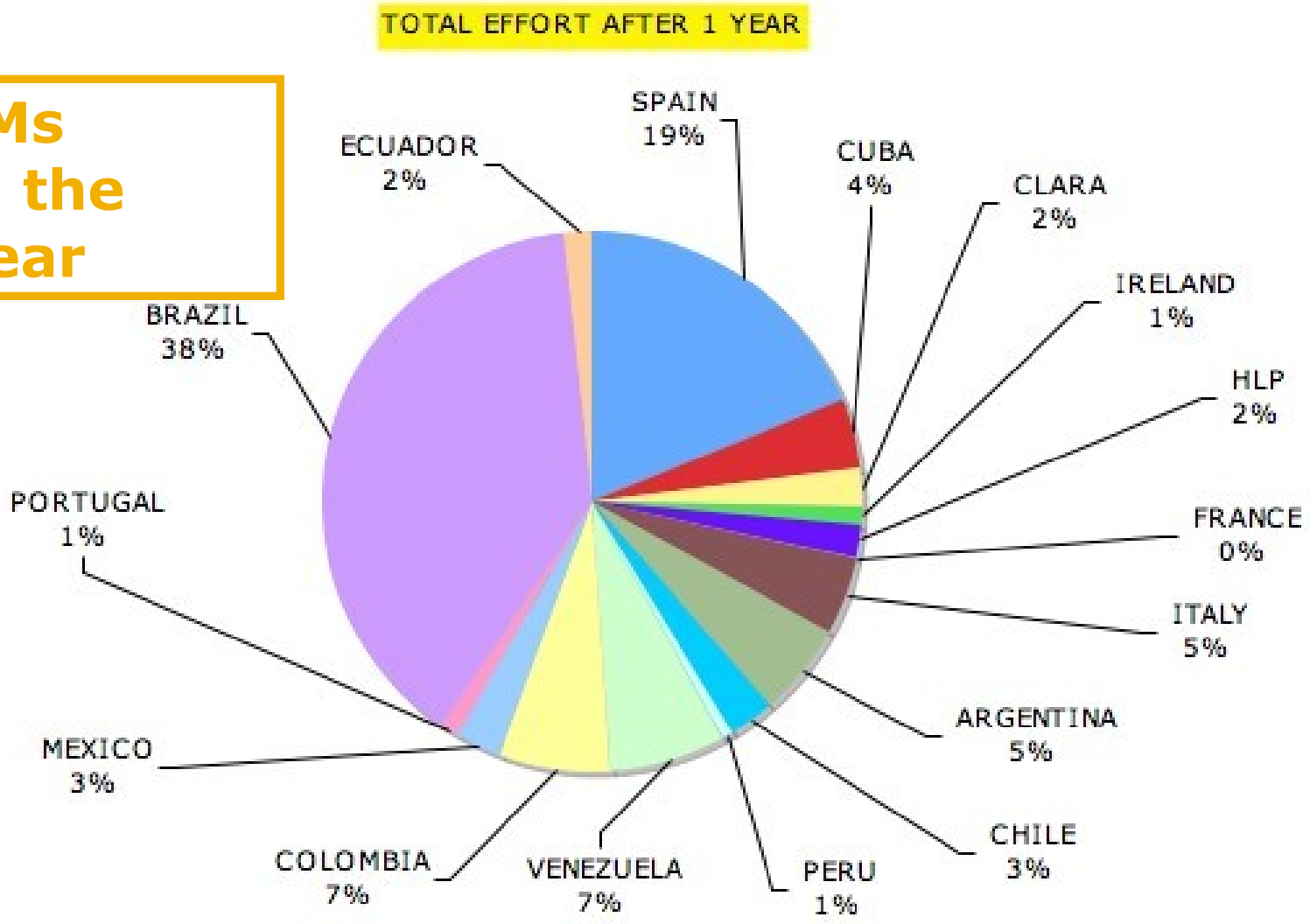
# EELA-2 achievements - NA1



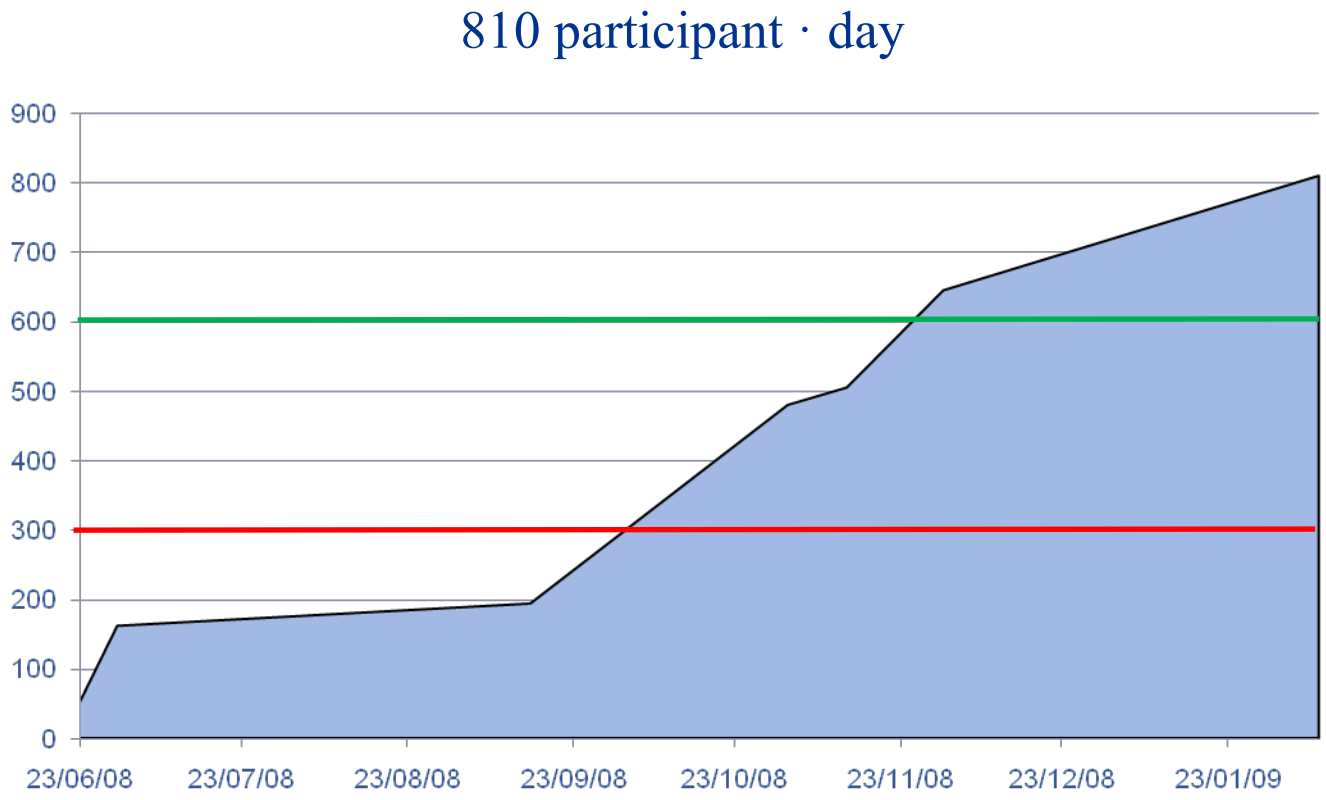

**Management participation in non-EELA-2 events**

# Total EELA-2 effort

**703 PMs during the first year**



# Training attendance well beyond expectation




Project goals
DoW

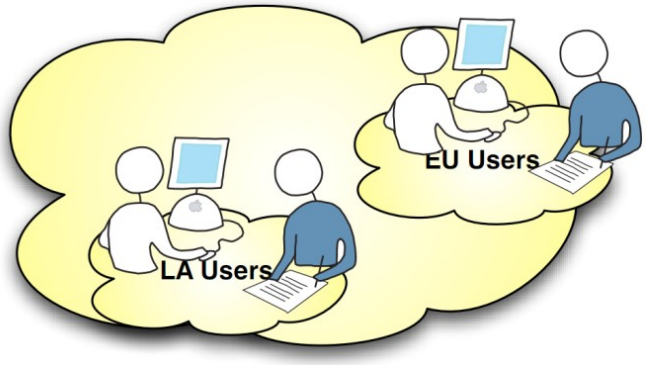
600 by year 2

300 by year 1

# The EELA-2 Gridification Universe

GILDA training-infrastructure

Grid Schools




Tutorials

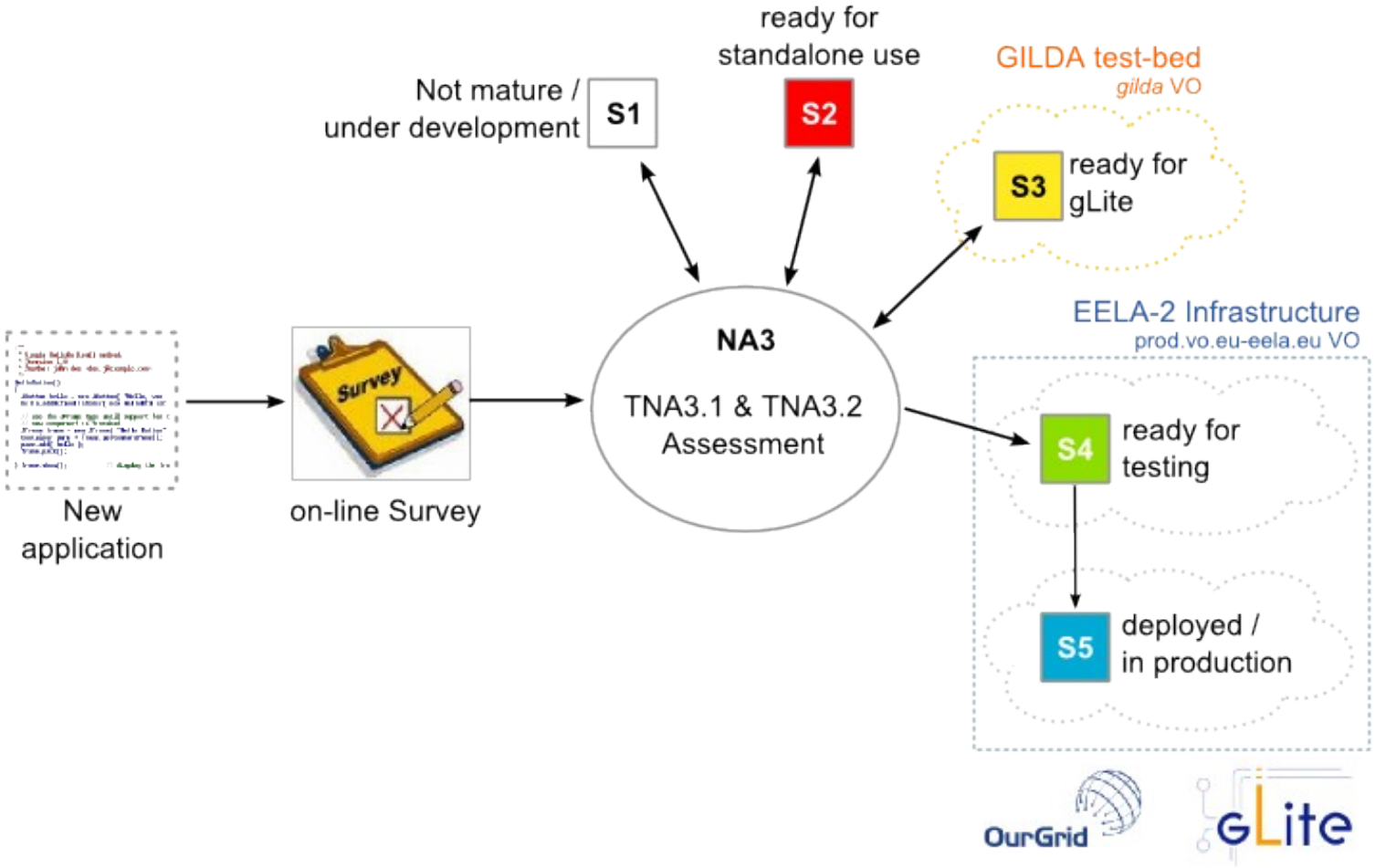
Support system

Wiki pages / EOC website

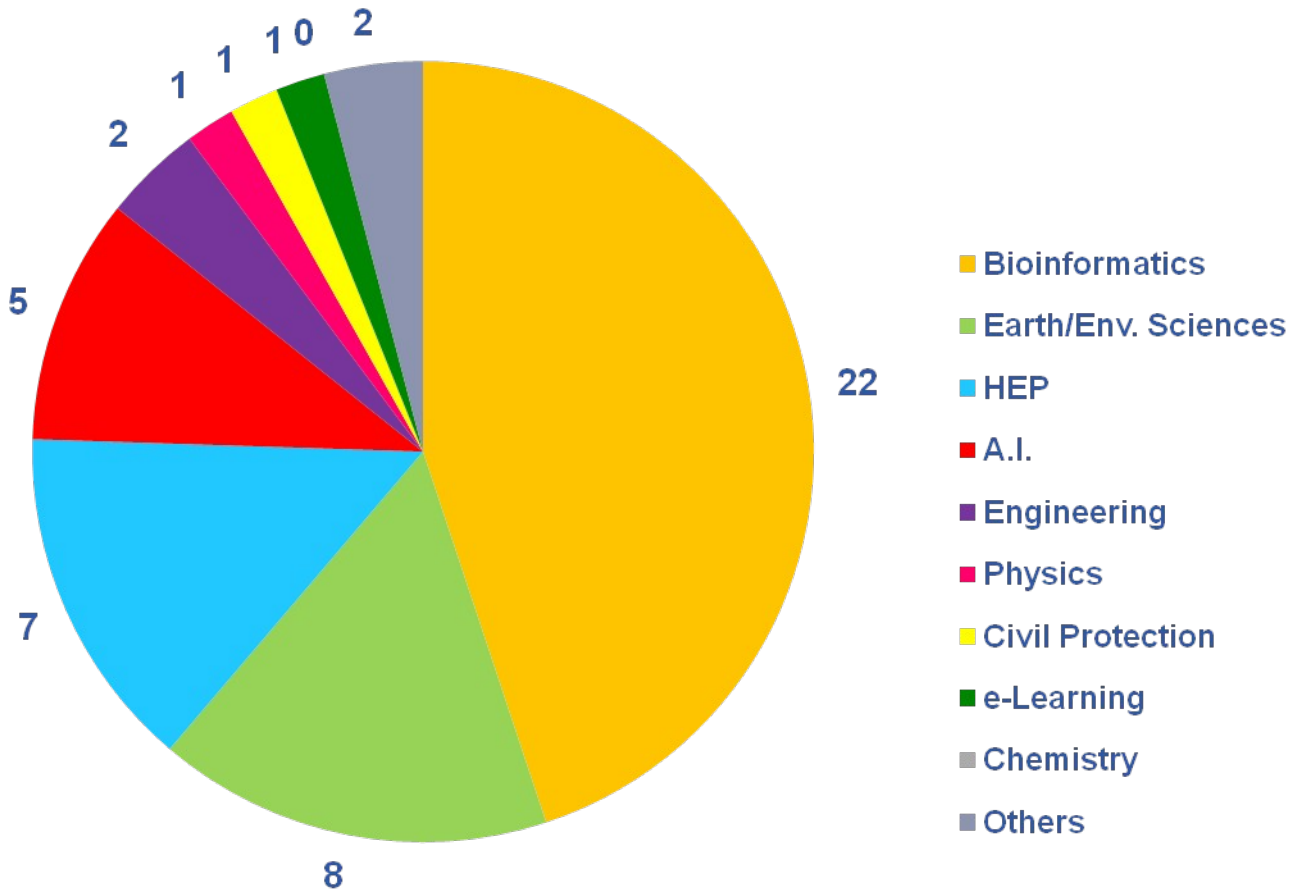
Gridification team

Gridification Weeks

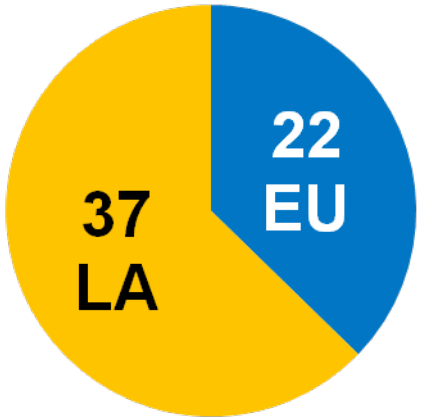
# Application lifecycle

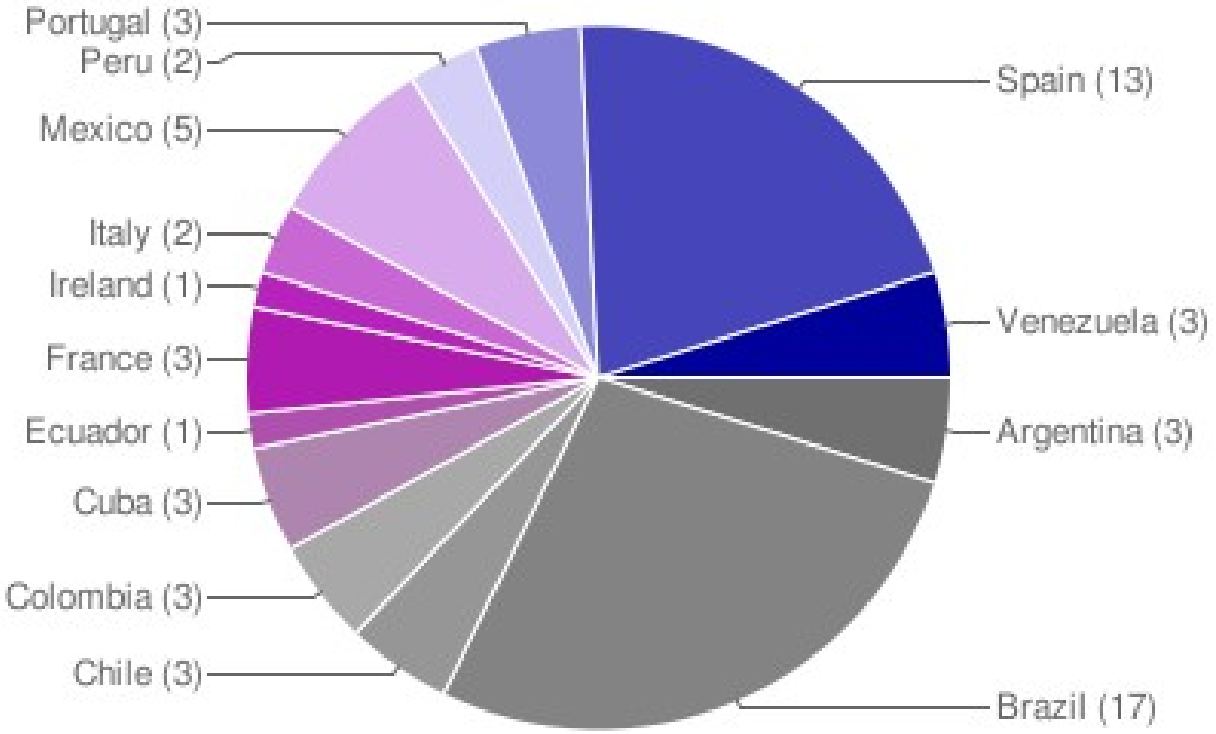


# Applications distribution per scientific domain



# Applications distribution per country



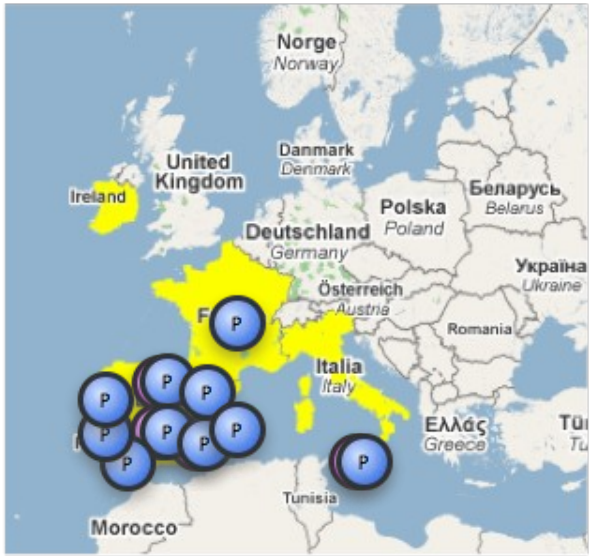



# Every EELA-2 country has access to the LA PKI



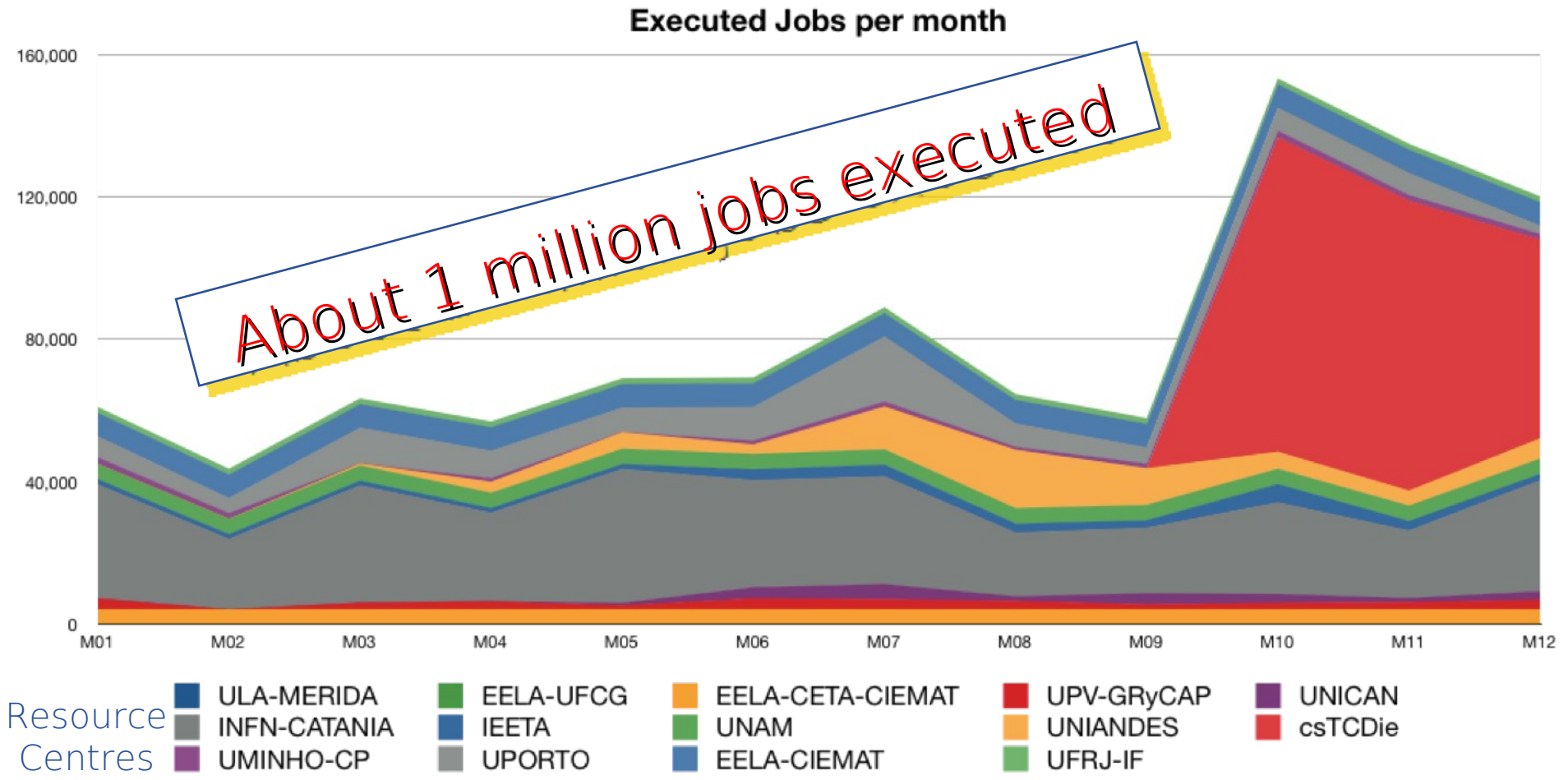
- CA — Certification Authority
- RA — Registration Authority
- A — CA Applicant
- CAll — Catch All Certification Authority

# Resource Centres Map

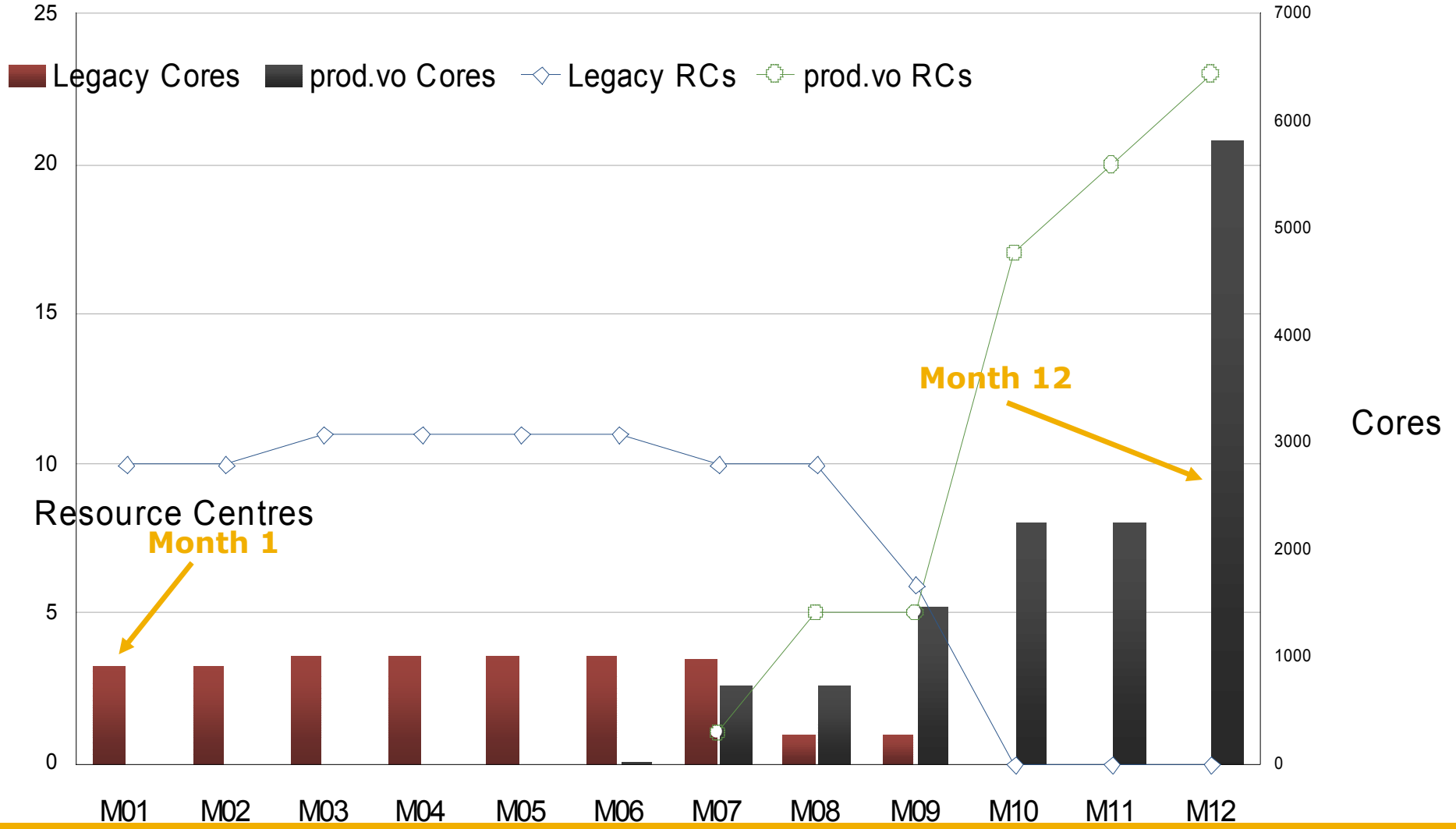




- Legacy Sites
- prod.vo Sites
- OurGrid Sites

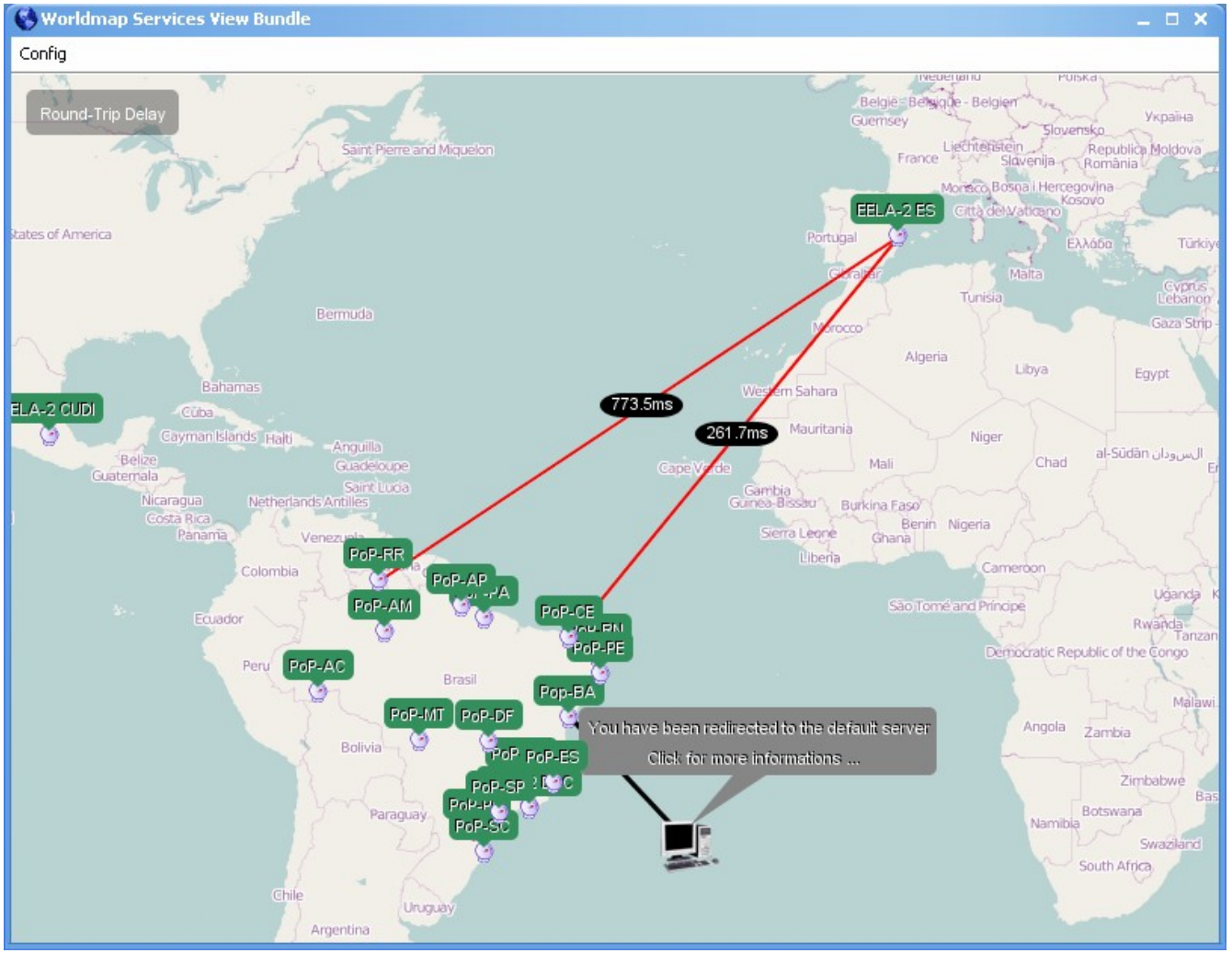
# Infrastructure Usage - all VOs



# Computing Resources



# Monitoring Delay Across EELA-2 and NREN (RNP) domains



# Activity Goals

- **Making the e-Infrastructure more useful and wide spread to increase its reach …**
  - Execution of grid middleware on top of different platforms, including Microsoft Windows
  - Scavenging of idle resources, particularly in shared desktops

  **… and its usability**
  - New application-oriented grid services
  - Support for the integration of a lightweight opportunistic grid middleware (OurGrid) whose development is led by one of the consortium members

- **With the effect of helping in fostering the sustainability of the e-Infrastructure**

# Results of the first year (1/3)

- **EELA-2 software repository available**
- **PKI-enabled OurGrid middleware available**
- **Prototypes of the application-oriented proposed services**
  - Data Management
    - Digital archives
    - Secure storage
    - Cooperative annotation of data
  - Job management
    - VO compliant Virtual Machine environments
    - Workflow for OurGrid jobs
- **Prototypes of the application-oriented additional services**
  - Job management
    - WatchDog
      - *Allows the monitoring and control of job execution on the gLite Worker Node*
  - Catalogue and file management
    - lgc-rec toolkit
      - *Implements a recursive version of the lgc-* suite of commands*

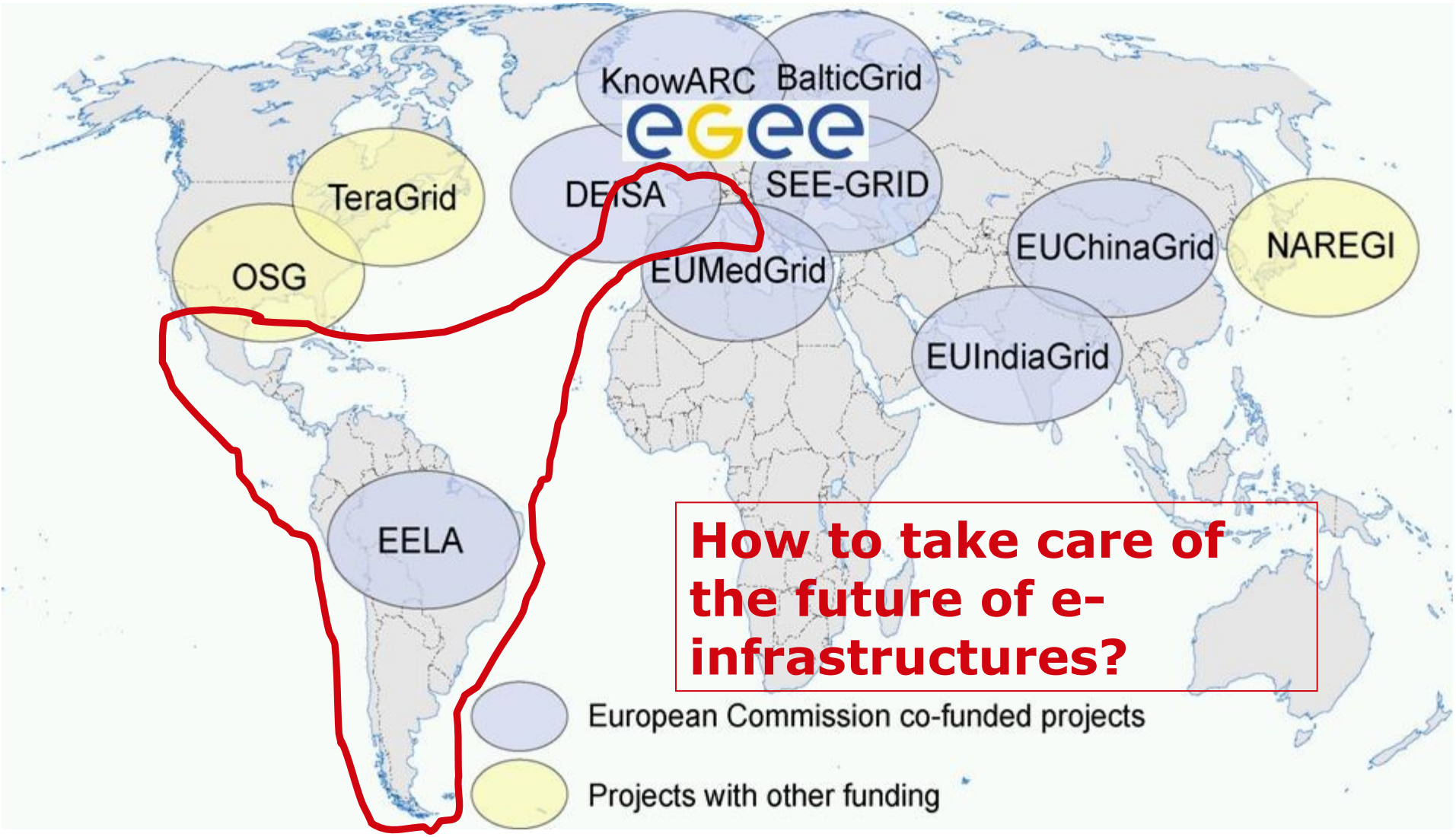
# Results of the first year (2/3)

- **Prototypes of the infrastructure-oriented proposed services**
  - Port of gLite to Microsoft Windows platforms
    - User Interface
      - *Grid Security Infrastructure*
      - *Workload Management*
      - *File Transfer*
      - *Data Management*
      - *Information System*
    - Computing Element
      - *The farm is composed by a unique central node with Linux operating system in which the Gatekeeper and the Torque/MAUI head node are running*
      - *A set of worker nodes with our rebuilt version of the gLite WN package implement the farm workers*

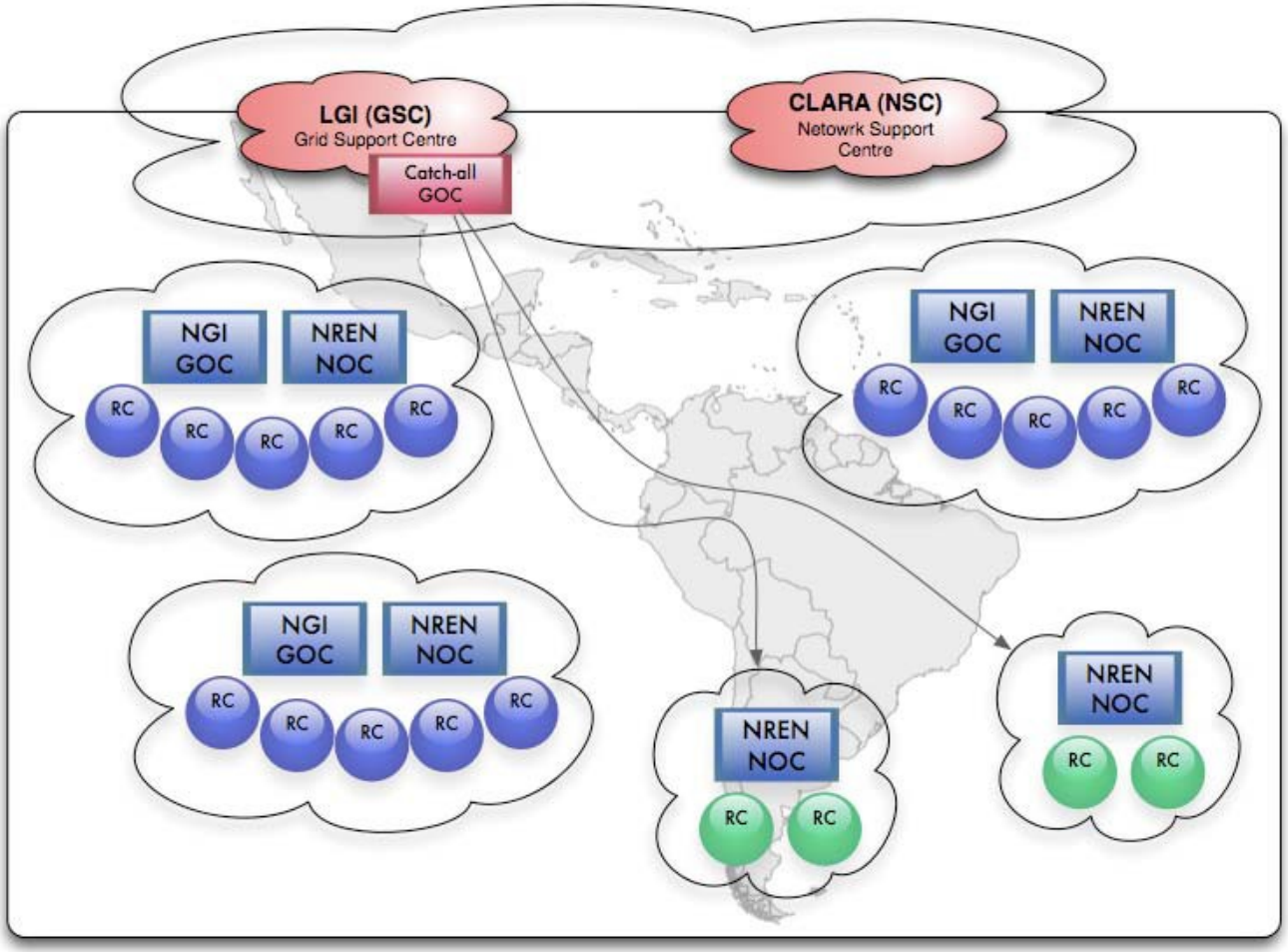
# Results of the first year (3/3)

- **Prototypes of the infrastructure-oriented additional services**
  - Support for grid operation
    - SAGE (Storage Accounting for Grid Environments)
    - Multiple middleware resource centres
      - *gLite and Globus Toolkit 4 (GT4)*
        - User Interface having clients for both gLite and GT4
        - A single cluster running both a gLite and a GT4 Computing Element
      - *Co-existence of gLite and OurGrid*
        - Scavenging of idle cycles in dedicated resources running gLite
        - Increased support for Bag-of-Tasks (BoT) applications through the OurGrid middleware

# The “global” Grid coverage

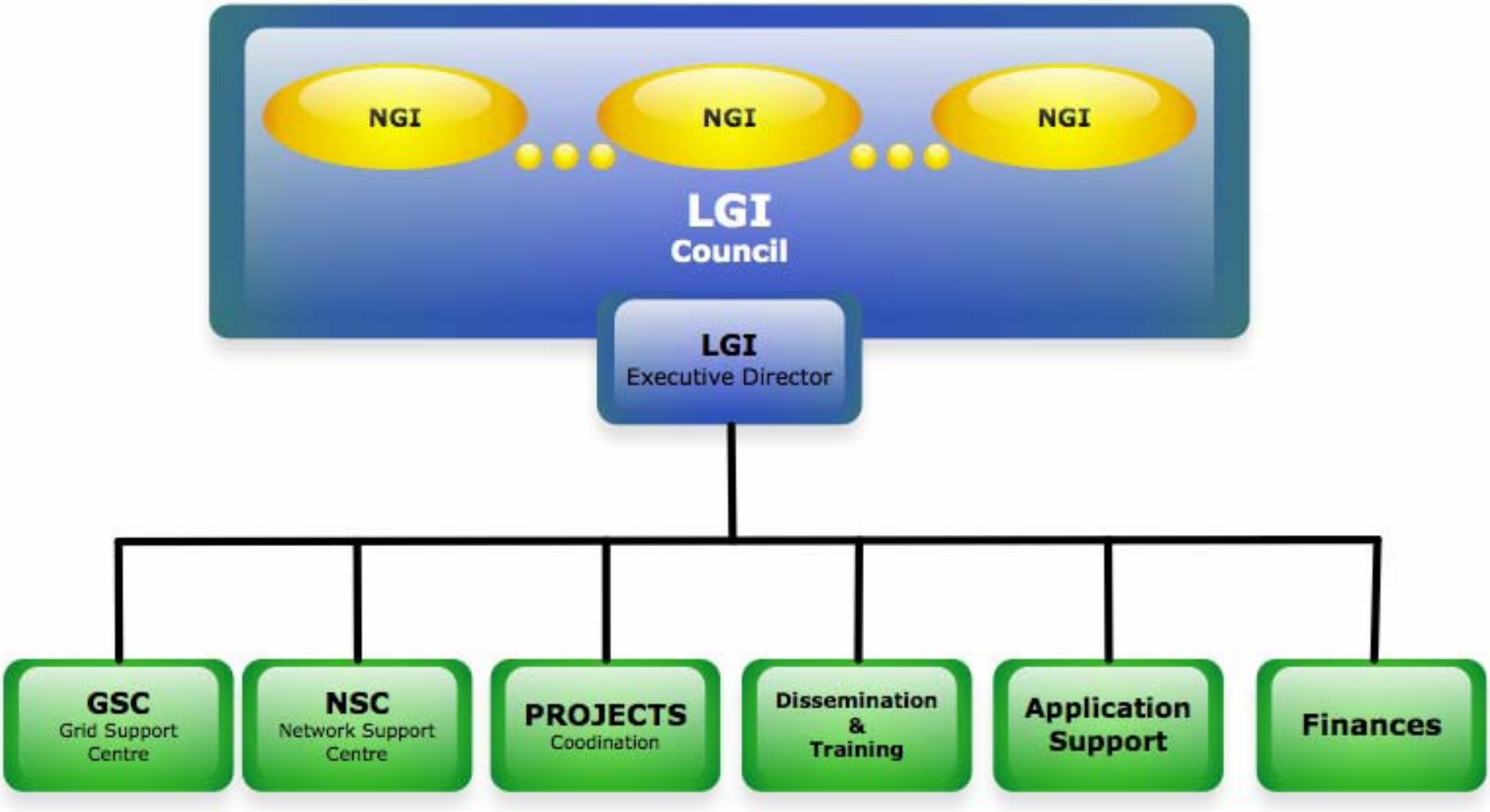


# The Latin American Grid Initiative (LGI)
## (http://documents.eu-eela.org/record/1119/files/)

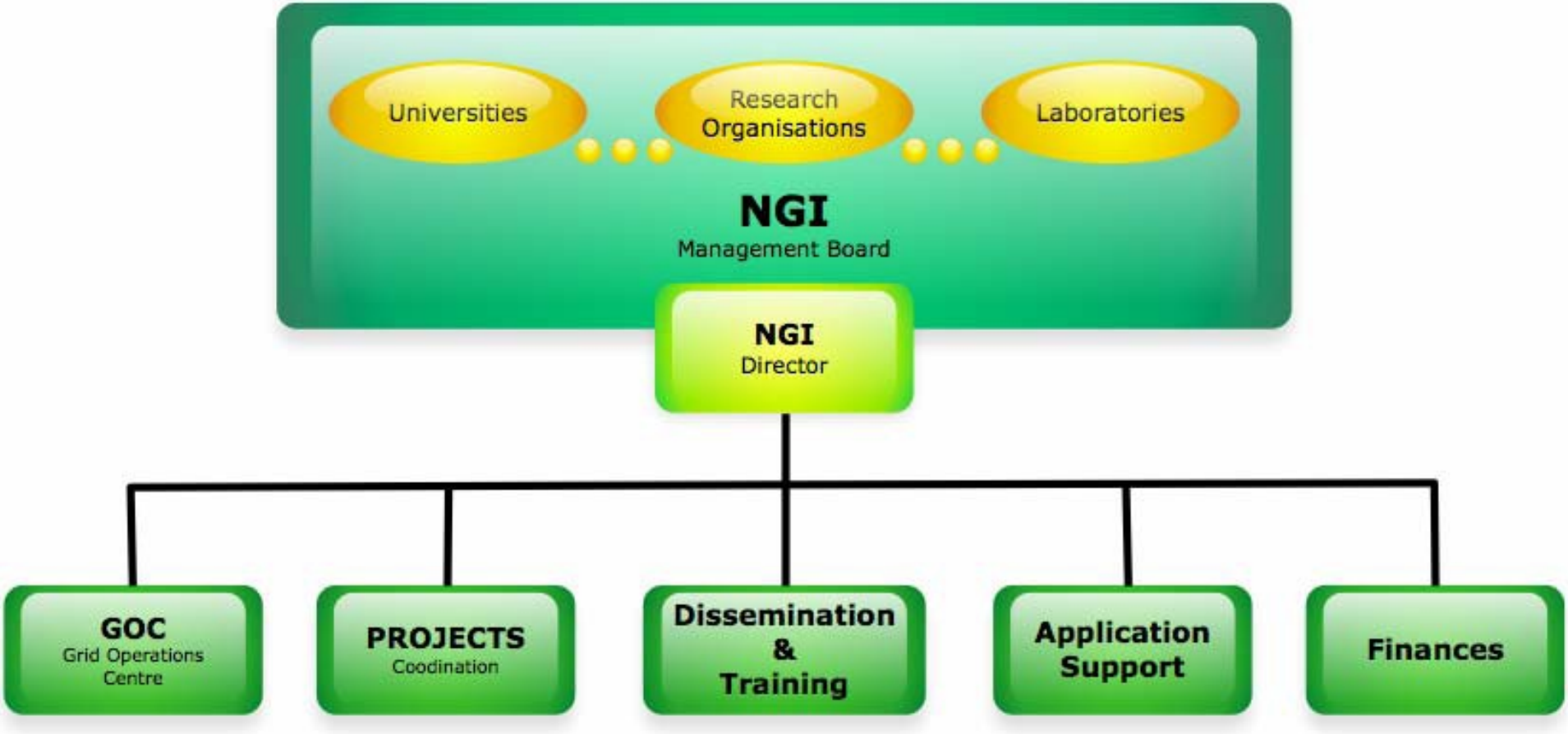



(**RC**: Resource Centre, **NGI**: National Grid Initiative, **GOC**: Grid Operation Centre, **NREN**: National Research & Education Network, **NOC**: Network Operation Centre, **LGI**: Latin American Grid Initiative, **CLARA**: Cooperación Latino Americana de Redes Avanzadas, **GSC**: Grid Support Centre, **NSC**: Network Support Centre)

# LGI Management/Governance



# A possible structure of a Latin American NGI




**A strong liaison with the NREN is strongly suggested/recommended. Local conditions permitting, the NGI should be incorporated into the NREN.**

# Long-term sustainability status

- Long-term sustainability of e-Infrastructures world wide is key for a continued support of scientific communities
- EELA-2 is definitely contributing to the establishment of JRUs and NGIs in Latin America, in close synergy with NRENs and CLARA, also in countries not initially involved in the project
- EELA-2 has defined a detailed model and architecture of the Latin American Grid Initiative
- Contacts with CLARA have formally been established and a Joint Committee has been formed at the Bogotá Conference (with Spanish participation) to analyse, agree on, and start implementing the proposed model

# After EELA-2: CHAIN?

- **No EELA-3 foreseen (at first sight), then …**
- **Co-ordination and Harmonisation of Advanced e-INfrastructures**

**Objective**

- Design study of the collaboration scheme between EGI and non-European Grid infrastructures

- **Time scale**
  - Transition period to EGI start early 2010 (also end of several Grid-related projects) to typically 2011

- **Vision / Facts** *(from the common "Input to EC programme")*
  - "It is clear from the current projects that one cannot revert to a European-only model since many of the user communities currently supported are already of a global dimension"
  - "Ongoing efforts of inter-projects coordination and collaboration are converging and deemed to be supported"
  - "There is an enormous variation in the level of maturity and organisational models of the regional Grid which want to contribute to EGI"

# CHAIN Proposal

- **Mission**
  - Ensure a successful long-term collaboration of EGI with non-European Grid Infrastructures by:
    - Supporting / Accompanying the progressive maturation of NGIs,
    - Supporting / Accompanying the ramp-up of the interaction with "non-EGI" regions
    - Accompanying the organisation of scientific domain specific collaborations (VOs)

- **Model**
  - EGI Europeans partners acting as tutors / advisors of several countries / regions
  - Two types of support
    - General support
      - *Dissemination & Training*
      - *Standard operational tools & procedures*
      - *Basic Interoperability & new services (RESPECT)*
      - *Policies*
      - *Community-based coordination*
    - Specific support depending of the regional grid's maturity and immediate goals

# CHAIN Proposal

- **Possible grouping per Infrastructure maturity level**
  - Regions completely green field to be supported from scratch
    - List: Sub-Saharan Africa countries
    - Specific support: Training periods in Europe, catch-all ROC
  - Regions already at a good / promising level needing support in the management of operations
    - List: Mediterranean, LA & Caribbean countries
    - Specific support: Training locally, catch-all ROC
  - Advanced countries / regions already autonomous but willing to interoperate
    - List: China, India, USA, Japan, etc.
    - Specific support: Interoperability, community-based services ?
- **EC calls opened in July 2009**

- **WEBSITE (EELA-2 & EELA):**

**www.eu-eela-eu**

**with access to**
**INDICO (Events) and INVENIO (Documents)**

- **WIKIs for more technical information**

# Sites of interest

- OGF, www.gridforum.org
- Links to grid projects and initiatives
  - Globus, www.globus.org
  - OSG, www.opensciencegrid.org
  - EGEE, www.eu-egee.org
  - **EELA-2**, www.eu-eela.eu
  - OurGrid, www.ourgrid.org
  - DEISA, www.deisa.org
  - EGI, www.eu-egi.org
  - Gridbus, www.gridbus.org
  - Grid Computing Info Centre, www.gridcomputing.com
  - GridCafé, www.gridcafe.org
  - ...

# Main conferences and journals

- Grid Computing
- Super Computing
- High performance and distributed computing
- Cluster and grid computing
- Grid and Pervasive Computing
- Global and Peer-to-Peer Computing
- Journal of Grid Computing
- Journal of High Performance applications
- Journal of Parallel and Distributed Computing
- Concurrency and Computation: Practice and Experience

# Research Challenges

- Applications
- Programming models and tools
- System architecture
- Algorithms and problem solving methods
- Resource management
- Data management
- Security
- Instrumentation and performance analysis
- End systems
- Network protocols and infrastructure

Source:

The Grid: Blueprint for a New Computing Infrastructure
by Ian Foster and Carl Kesselman

# Bibliography


- *Grid Computing: Making the Global Infrastructure a Reality*, F. Berman, G. C. Fox and A. J. G. Hey editors, Wiley, 2003, ISBN 0-470-85319-0.
- *The Grid 2: Blueprint for a New Computing Infrastructure* (The Elsevier Series in Grid Computing) by Ian Foster and Carl Kesselman (Hardcover - Nov 18, 2003)
- *The Grid Technology Cookbook, Mary Trauner and Mary Fran Yafchak*
- various articles

# Suggested papers

- The Grid: A New Infrastructure for 21st Century Science.

  I. Foster
- The Anatomy of the Grid: Enabling Scalable Virtual Organizations.

  I. Foster, C. Kesselman, S. Tuecke.
- The Physiology of the Grid: An Open Grid Services Architecture for Distributed Systems Integration.

  I. Foster, C. Kesselman, J. Nick, S. Tuecke.