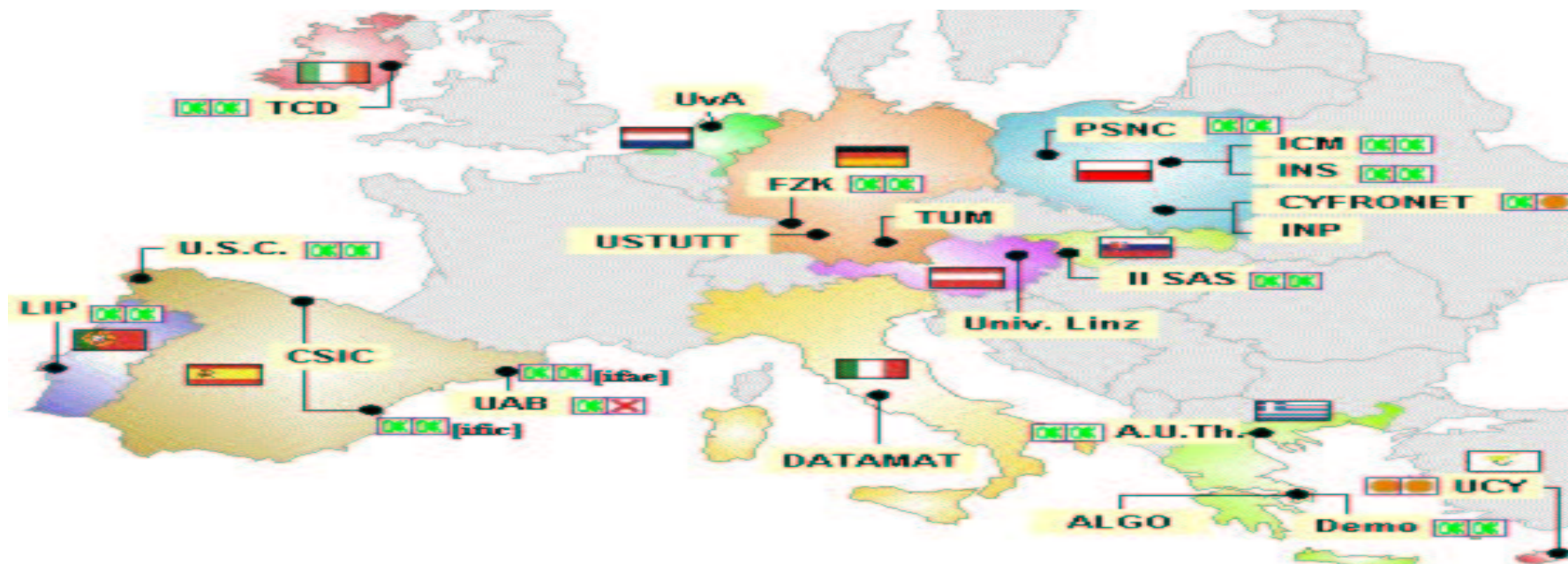# Status of the CrossGrid Testbed
## EDG WP6 Meeting, Barcelona

*Jesús Marco (marco@ifca.unican.es)*
Instituto de Física de Cantabria, IFCA
Consejo Superior de Investigaciones Científicas, **CSIC,** Santander, SPAIN
grid.ifca.unican.es/crossgrid/wp4

# First Prototype of the CrossGrid Testbed

J.Gomes[1], M.David[1], J.Martins[1], L.Bernardo[1], J.Marco[2], R.Marco[2],
D.Rodríguez[2], J.Salt[3], S.Gonzalez[3], J.Sánchez[3], A.Fuentes[4], M.Hardt[5],
A.García[5], P.Nyczyk[6], A.Ozieblo[6], P.Wolniewicz[7], M.Bluj[8], K.Nawrocki[9],
A.Padee[8,9,10], W.Wislicki[8,9], C.Fernández[11], J.Fontán[11], A.Gómez[11],
I.López[11], Y.Cotronis[12], E.Floros[12], G.Tsouloupas[13], W.Xing[13],
M.Dikaiakos[13], J.Astalos[14], B.Coghlan[15], E.Heymann[16], M.Senar[16],
G.Merino[17], C.Kanellopoulos[18], and G.D.van Albada[19]

[1] Laboratório de Instrumentacão e Física de Partículas, Lisbon, Portugal
[2] Instituto de Física de Cantabria (CSIC),Santander, Spain
[3] Instituto de Física Corpuscular(CSIC),Valencia, Spain
[4] RedIris(CSIC),Madrid, Spain
[5] Forschungszentrum Karlsruhe GMBH, Germany
[6] Akademickie Centrum Komputerowe CYFRONET, Krakow, Poland
[7] Poznan Supercomputing and Networking Center, Poznan, Poland
[8] A.Soltan Institute for Nuclear Studies, Warsaw, Poland
[9] Interdisciplinary Centre for Mathematical and Computational Modelling, University of Warsaw,Poland
[10] Instytut Radioelektroniki PW, Warsaw, Poland
[11] CESGA, Centro de Supercomputacion de Galicia, Santiago de Compostela, Spain
[12] National Center for Scientific Research "Demokritos", National and Kapodistrian University of Athens, Dep. of Informatics and Telecommunications, Greece
[13] University of Cyprus, Cyprus
[14] Ustav Informatiky Slovenska Akademia Vied, Bratislava, Slovakia
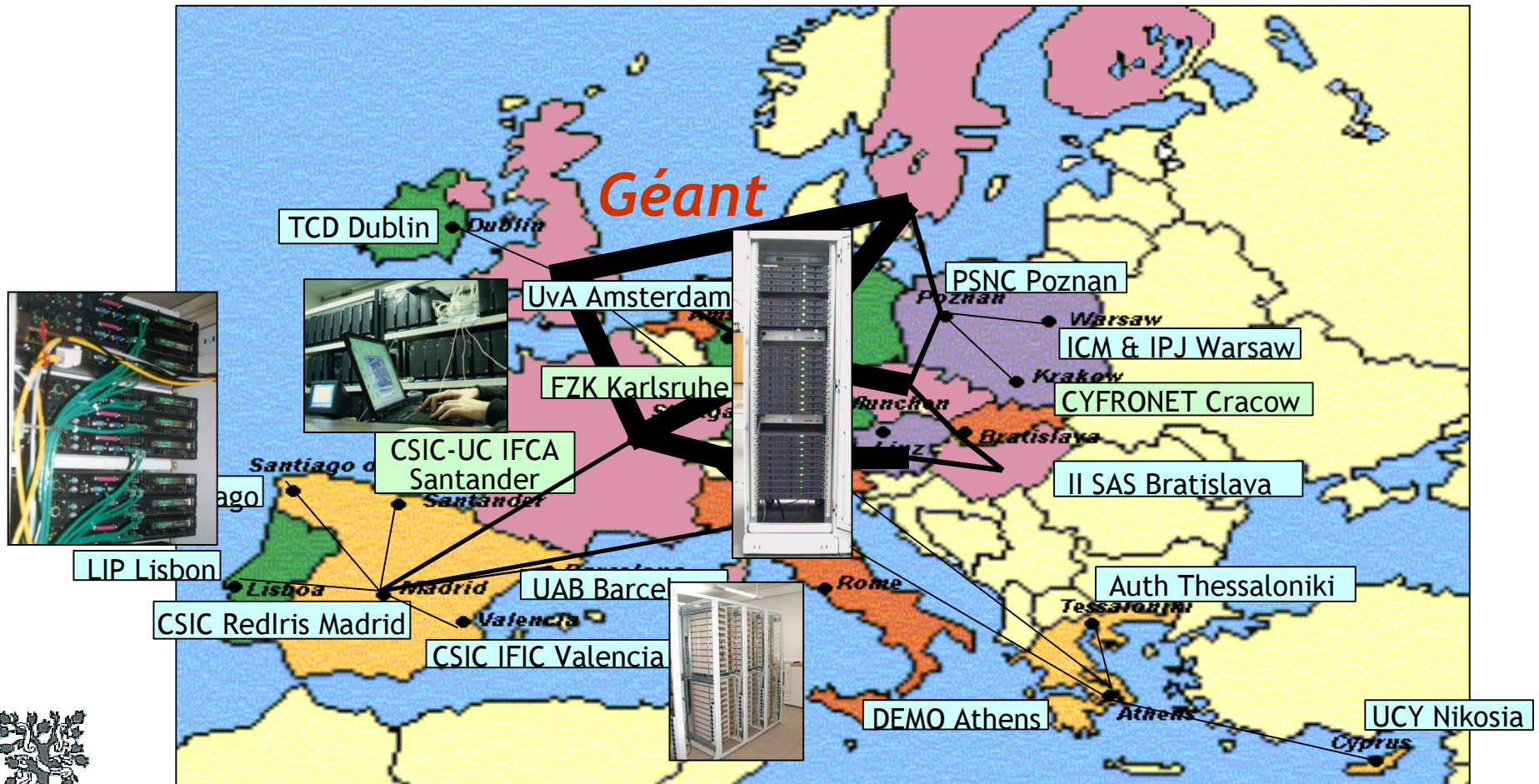[15] Trinity College Dublin, Ireland
[16] Universitat Autonoma de Barcelona, Spain
[17] Institut de Fisica d'Altes Energies, Barcelona, Spain
[18] Aristotle University of Thessaloniki, Greece
[19] Universiteit van Amsterdam, Netherlands

# The CrossGrid Testbed

- A collection of distributed computing resources
  - 16 sites (small & large) in 9 countries, connected through *Géant* + NRN
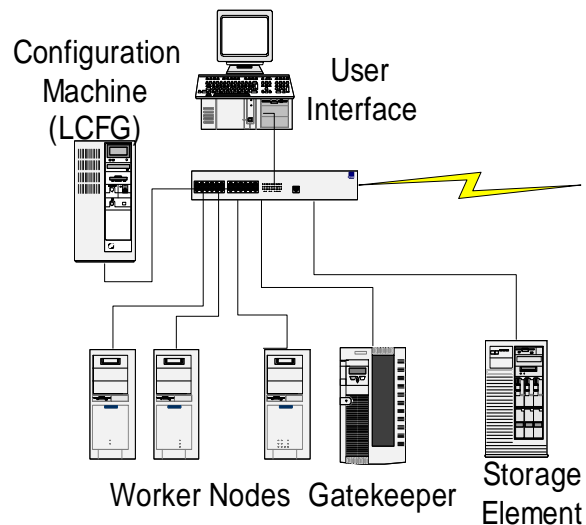  - + Grid Services:  EDG middleware (based on Globus) RB, VO, RC…



*Géant*

TCD Dublin
UvA Amsterdam
PSNC Poznan
ICM & IPJ Warsaw
FZK Karlsruhe
CYFRONET Cracow
CSIC-UC IFCA Santander
II SAS Bratislava
LIP Lisbon
CSIC RedIris Madrid
UAB Barcel
Auth Thessaloniki
CSIC IFIC Valencia
DEMO Athens
UCY Nikosia

# Human resources

*"An exceptional integration & site support team"*

LIP  Jorge, Mario
FZK Marcus, Ariel
IFIC Javier, Santi
IFCA Rafa
CESGA/USC Carlos, Javier
UAB Gonzalo
AuTH Christos
DEMO Vangelis
IISAS Jan
PSNC Pawel
CYFRONET Piotr
ICM/IPJ Adam, Michal
TCD Brian
UCY George

# Computing resources



Configuration Machine (LCFG)
User Interface
Worker Nodes  Gatekeeper  Storage Element

CA machine (offline)
Monitoring
MyProxy
Resource Broker
Replica Catalogue
Virtual Organization

- **Site testbed**
  - LCFG configuration server
  - User Interface
  - Gatekeeper (Computing Element)
  - Worker Nodes
  - Storage Element

- **16 sites:**
  - 115 CPUs (Worker Nodes)
  - 4 TB (Storage Elements)

- **National Certification Authority machines**

- **Grid services (LIP)**
  - Information Index
    - Top MDS Information Server, points to site Information Servers
  - Resource Broker
    - Matchmaking and load balancing scheduler
  - Replica Catalogue
    - Database for physical replica file location
  - Certificate Proxy Server
    - Short lived certificates for long lived processes, used by RB
  - Virtual Organization Server
    - Database for user authentication (CROSSGRID VO)
  - Monitoring
    - Mapcenter: network monitoring system
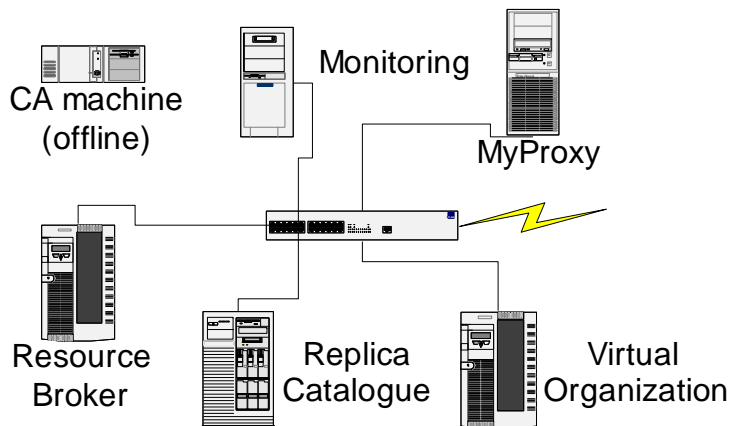
# Testbed Status

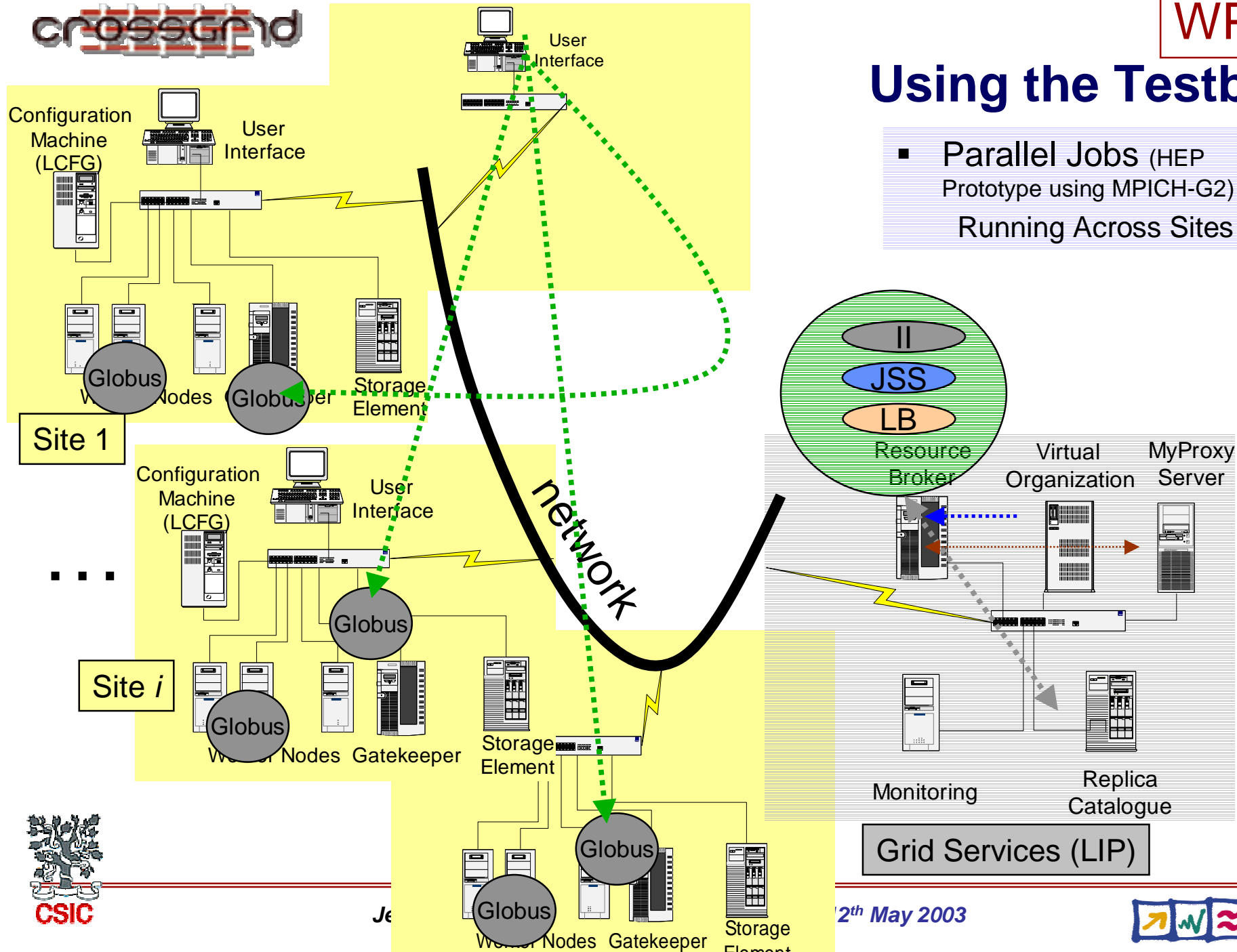| Site | Location | Status |
|------|----------|--------|
| CYFRONET | Cracow | Running 1.4.4, Deploying 1.4.8 |
| ICM | Warsaw | Running 1.2.2, Deploying 1.4.8 |
| INS | Warsaw | Running 1.2.2, Deploying 1.4.8 |
| UvA | Amsterdam | Deployed 1.2.2. |
| FZK | Karlsruhe | Running 1.4.8 |
| IISAS | Bratislava | Running 1.2.3. |
| PSNC | Poznan | Running 1.2.2. |
| UCY | Nikosia | Deploying 1.4.8 |
| TCD | Dublin | Running 1.2.3, Deploying 1.4.11 |
| CSIC/IFIC | Valencia | Running 1.2.3, Deploying 1.4.8 |
| CSIC/IFCA | Santander | Deploying 1.4.8 |
| UAB | Barcelona | Deploying 1.4.8 |
| USC/CESGA | Santiago | Running 1.2.2, Deploying 1.4.8 |
| Demokritos | Athens | Running 1.4.8 |
| AUTH | Thessaloniki | Running 1.2.2. |
| LIP | Lisbon | Running 1.4.11 |

# Using the Testbed
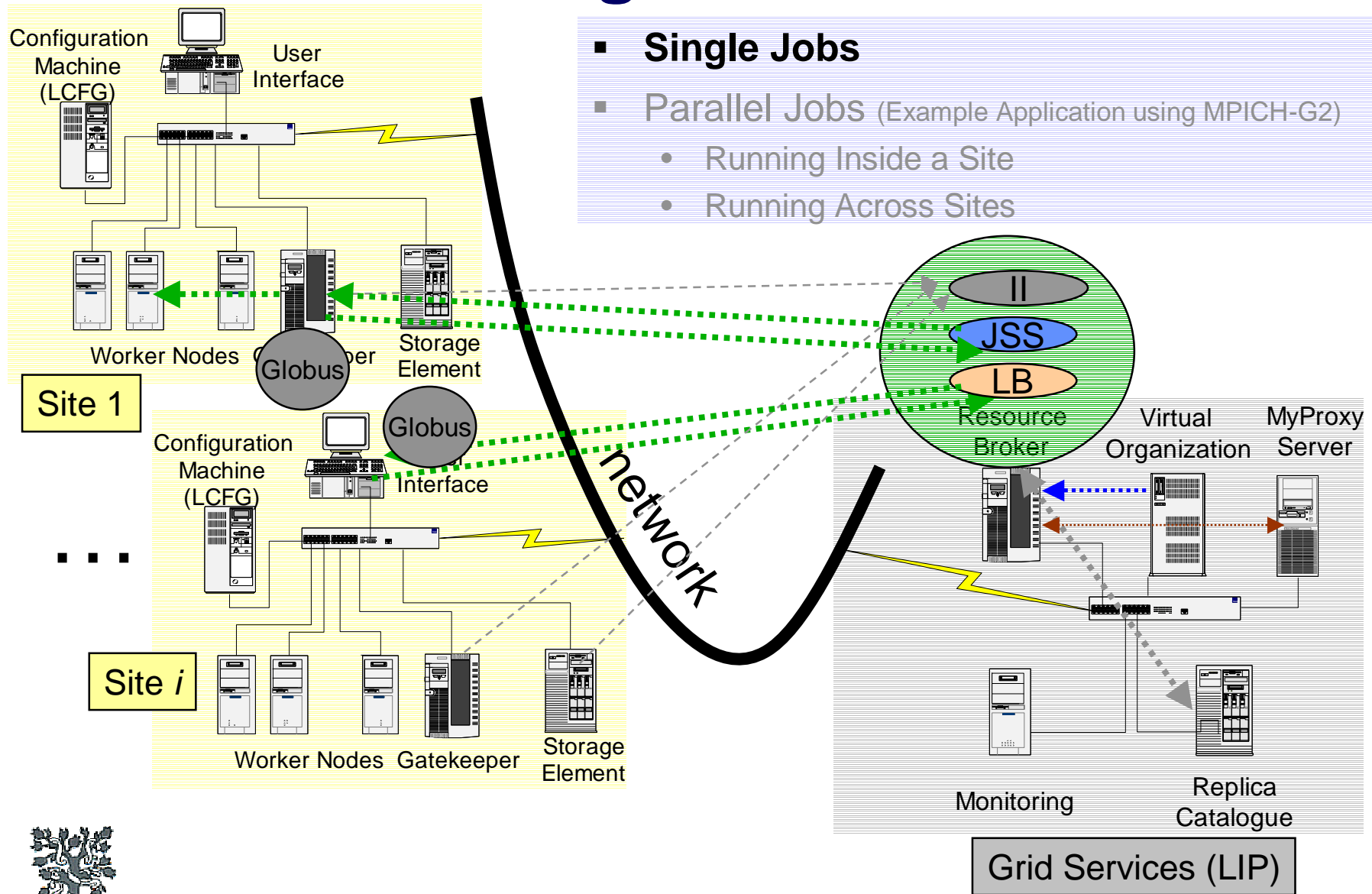
- **Single Jobs**
- Parallel Jobs (Example Application using MPICH-G2)
  - Running Inside a Site
  - Running Across Sites

**WP4**

# Using the Testbed

- Parallel Jobs (HEP Prototype using MPICH-G2)

  Running Across Sites

Configuration Machine (LCFG)

User Interface

Globus

Worker Nodes

Globuster

Storage Element

**Site 1**

Configuration Machine (LCFG)

User Interface

Globus

Globus

**Site i**

Worker Nodes   Gatekeeper   Storage Element

network

Globus

Globus

Worker Nodes   Gatekeeper   Storage Element

II

JSS

LB

Resource Broker

Virtual Organization

MyProxy Server

Monitoring

Replica Catalogue

Grid Services (LIP)

*Je...*                    *12th May 2003*                    8

# CrossGrid WP1 – Task 1.3 Distributed Data Analysis in HEP

## Subtask 1.3.2: Data-mining techniques on GRID

- **ANN: example of architecture 16-10-10-1**
  - **16 input variables**
  - **2 hidden layers with 10 nodes each**
  - **1 output layer, 1=signal, 0=background**
- **Trained on MC sample**
  - **Higgs generated at a given mass value**
  - **All types of Background**
  - **10x real data statistics**
- **Applied on real collected data to order in S/B the candidates to Higgs boson**
- **Training process:**
  - **Minimize classification "error"**
  - **Iterative process**
  - **No clear "best strategy"**
  - **Computing Intensive: hours to days for each "try"**



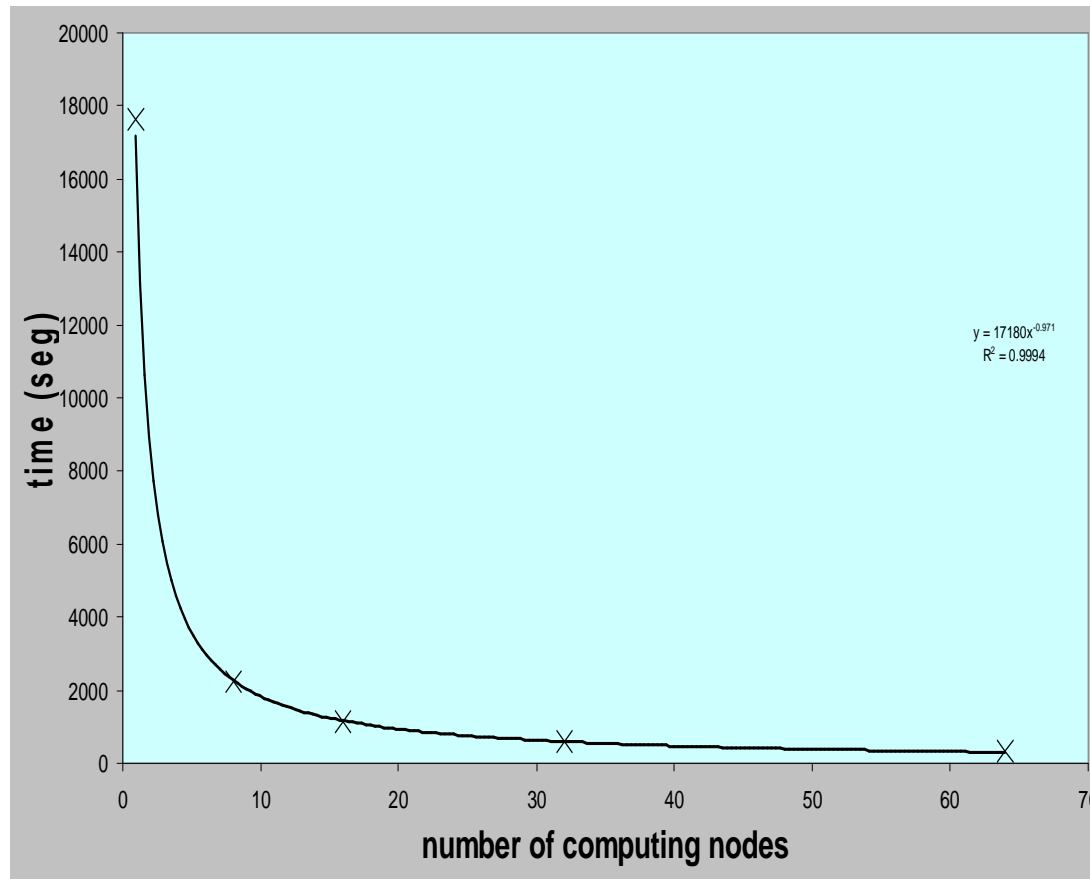ANN Higgs Analysis
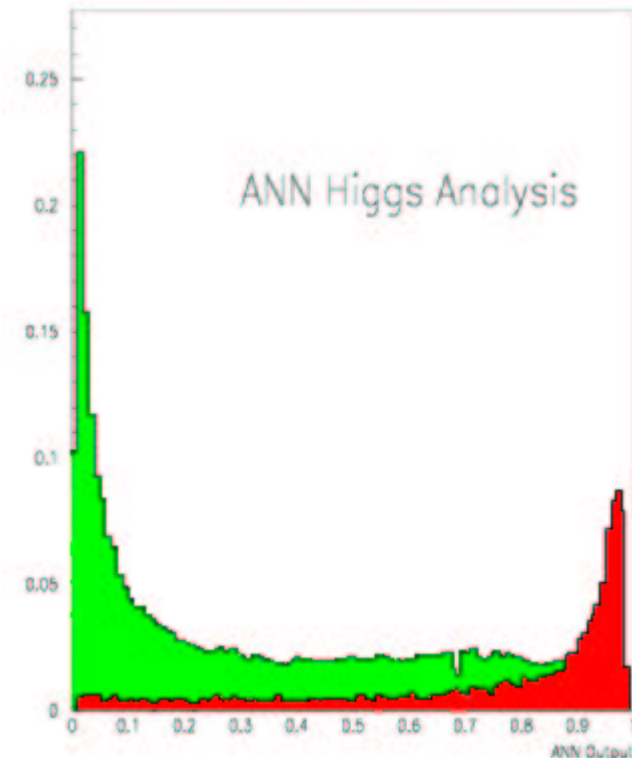
# Distributed Training Prototype

- Distributed Configuration:
  - Master node and N slave nodes.
    - Scan to filter events & select variables
    - ResultSet in XML, split according to N (number of slave nodes)

- Training procedure:
  - Master reads input parameters and sets the initial weights to random values.
  - The training data is distributed to the slaves.
  - At each step:
    - The master sends the weights to the slaves.
    - The slaves compute the error and the gradient and return them to the master.

- This training procedure has been implemented using MPI and adapting the MLP-fit package.

- Conditions:
  - train an ANN with 644577 simulated realistic LEP events, 20000 of them corresponding to signal events.
  - Use a 16-10-10-1 architecture (270 weights)
  - Need 1000 epochs training.
  - Similar sized samples for the test.
  - BFGS training method.

Output Layer

Hiden Layer

Input Layer
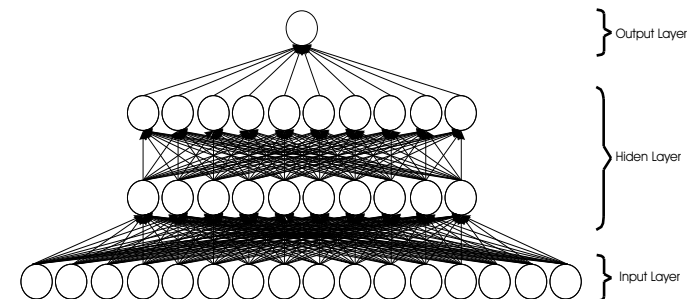
# Execution and results on a local cluster

First prototype on local cluster with MPI-P4



**Scales as 1/N**

$y = 17180x^{-0.971}$
$R^2 = 0.9994$

644577 events,
16 variables
16-10-10-1 architecture
1000 epochs for training

Time reduction:
from **5 hours**
down to **5 min**
using 60 nodes!

Modelling including latency  <300 ms needed !

# Running with MPICH-G2 in a local cluster

- Migration to MPICH-G2 required
  - Installation of certificates for users and machines
  - Globus 2 installation in cluster
  - Program rebuilt, statically linked
  - Installation of software in the CVS repository at FZK
  - Use of globus-job-run, resource allocation through `.rsl` file

- **DEMO (shown in Santiago, CrossGrid Workshop)**

  ann_compara.exe

  - Running in local cluster, comparing two configurations with
    - 1 node (master+slave)
    - 20 nodes (1 master+20 slaves)
  - Certificates for authentication
  - Graphics shown:
    - Basic: ERROR EVOLUTION WITH TRAINING PROGRESS (number of iterations or epochs)
    - Signal-Background separation: NN output (classification) vs Discriminating variables
      - AQCD =  Event shape
      - BTAG = Particles Lifetime
      - PWW, PZZ = Mass reconstruction

**M12 objective reached !!!**

# Running in the CrossGrid Testbed

**INTEGRATION AND DEPLOYMENT: Objective for these months!**

- Steps:
  - User (with certificate) included in CrossGrid VO, logs in User Interface machine
  - Resource Allocation:
    - Direct .rsl file
    - Need public IP
  - Job Submission:
    - Copy executables + input files to each node via an script with Globus tools
    - Submit as before (globus-job-run)
  - Output:
    - Graphical output via X11
    - NN (weights) in XML format
- **DEMO (also shown in Santiago, CrossGrid Workshop):**
  - Running in testbed:
    - User Interface in Santander, Master node in CE at LIP
    - Slaves at Valencia (IFIC), Karlsruhe (FZK), Krakow (CYFRONET)

ann_in_testbed.exe

# DEMO IN TESTBED

- MAP:



**http://mapcenter.lip.pt**
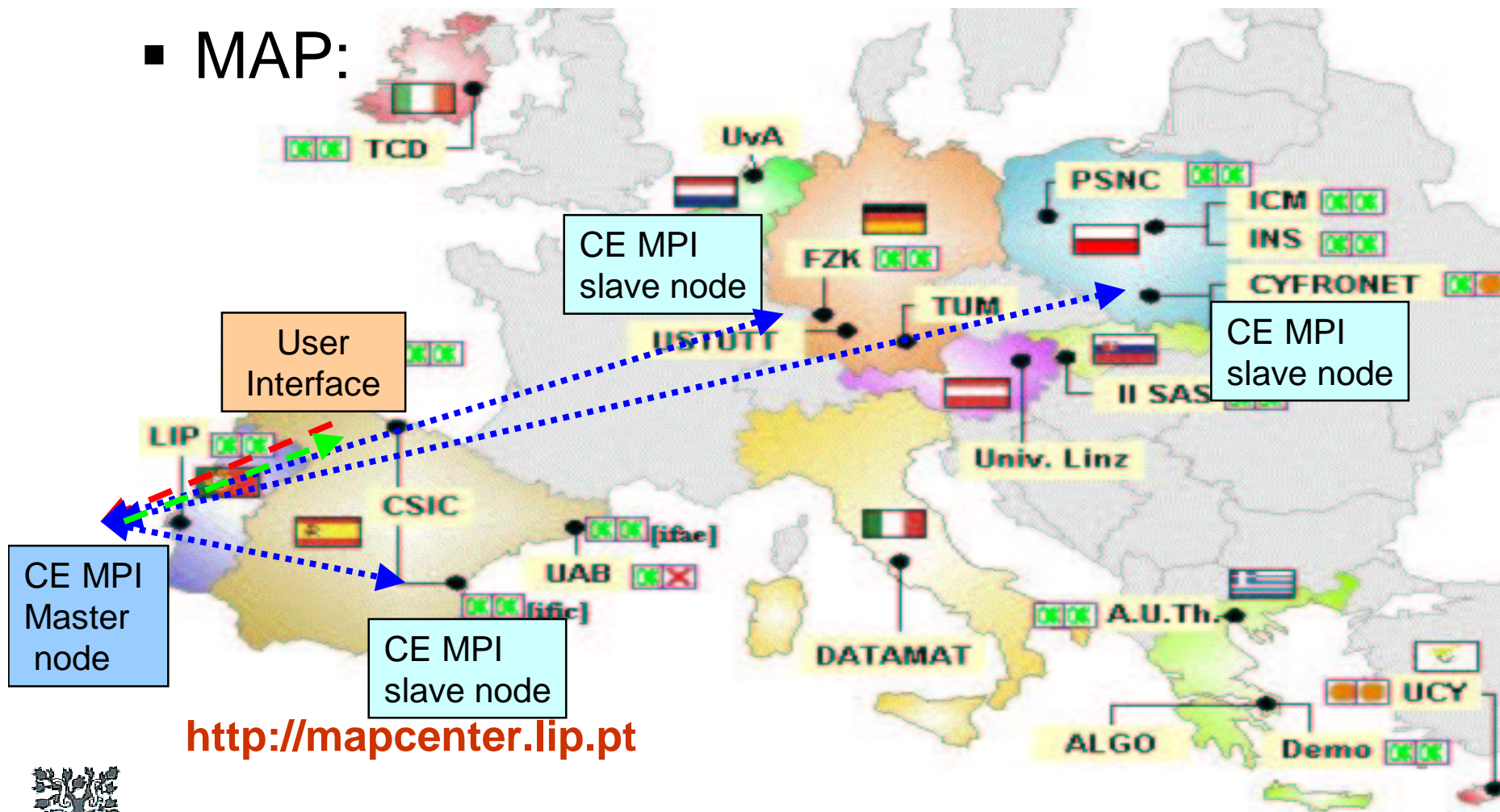
# More related integration work ...

- TOOLS (**DEMO**):
  - MPI Verification using MARMOT
    - Compilation with MARMOT
    - Running in the testbed
  - GPM & OCM-G
    - Monitoring

- GRID SERVICES:
  - ACCESS TO TESTBED RESOURCES **(DEMO)**
    - Use ROAMING ACCESS SERVER Via Portal or via Migrating Desktop
      - File transfer possibilities
  - JOB SUBMISSION (**DEMO**):
    - Job "parameters": build XML form and translate into JDL
    - Submission for single node using JSS
      - Migrating Desktop
      - Portal
    - Output:
      - Graphical output via X11 (tunnelled), or using SVG
  - Network tracing with SANTA-G
    - Dump and analysis of packets

# Testbed Evolution

- Initial testbed
  - Four initial sites, EDG 1.2, in July
  - Deployment of Grid Services at LIP in September
    - CrossGrid Virtual Organization server
    - Resource Broker, Replica Catalogue
- Current status:
  - **Production (Stable) testbed**
    - Objective: support applications
    - All sites, now with EDG 1.2.2/3, migrating to 1.4.8+  RH6.2+LCFG
  - **Validation testbed**
    - Objective: validation of new production middleware
    - LIP+FZK+DEMO, EDG 1.4.8+   RH6.2+LCFG
- Coming:
  - **Development testbed**
    - Objective: support development of new middleware and applications
    - Used in the integration process
    - Plan was EDG 2.0, now should be 1.4.8 but prefer RH7.3+LCFG-ng
    - Modified Resource Broker (MPI resources "finder")

Release path

# Production Testbed Use
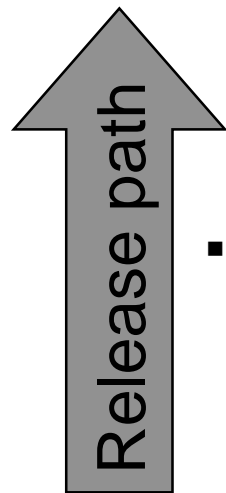
## Site Statistics

| Sites | Connect | Pings | Jobs OK | Failed Jobs | | | |
|---|---|---|---|---|---|---|---|
| | | | | LCAS | CRL exp | Jobman | GSS |
| LIP | 6556 | 462 | 2836 | 50 | 17 | 92 | 3099 |
| IFIC | 5326 | 655 | 2649 | 100 | 97 | 45 | 1780 |
| Cyfronet | 4516 | 306 | 2522 | 0 | 20 | 111 | 1557 |
| II SAS | 1404 | 6 | 1185 | 0 | 15 | 99 | 99 |
| FZK | 1799 | 11 | 1112 | 118 | 7 | 123 | 428 |
| Demo | 9481 | 5 | 1111 | 36 | 0 | 51 | 8278 |
| ICM | 705 | 34 | 604 | 8 | 24 | 2 | 33 |
| CESGA | 7321 | 1 | 544 | 78 | 28 | 13 | 6657 |
| UAB | 600 | 14 | 519 | 0 | 9 | 14 | 44 |
| INS | 592 | 2 | 517 | 6 | 20 | 20 | 27 |
| PSNC | 582 | 0 | 496 | 15 | 14 | 11 | 46 |
| TCD | 145 | 0 | 131 | 0 | 0 | 2 | 12 |
| AUTH | 141 | 0 | 127 | 0 | 3 | 0 | 11 |
| TOTAL | 39168 | 1496 | 14353 | 411 | 254 | 583 | 22071 |

## Resource Broker Statistics

| | |
|---|---|
| Total users | 33 |
| **Jobs submitted** | **1943** |
| Jobs accepted | 1904 |
| Jobs with good match | 1799 |
| Jobs submitted by JSS | 1781 |
| Jobs run | 1620 |
| **Jobs done** | **1070** |

Since the RB doesn't support parallel jobs, most job submissions pass unnoticed to the RB.

# Validation Testbed Use

## Site Statistics

| Sites | Connections | Pings | Jobs OK | Failed Jobs | | | |
|---|---|---|---|---|---|---|---|
| | | | | LCAS | CRL exp | Jobman | GSS |
| LIP | 67365 | 2319 | 64995 | 21 | 0 | 4 | 26 |
| FZK | 8883 | 64 | 8671 | 38 | 12 | 50 | 48 |
| Demo | 10665 | 0 | 6170 | 4 | 6 | 2 | 4483 |
| TOTAL | **86913** | 2383 | **79836** | 63 | 18 | 56 | 4557 |

## Resource Broker Statistics

| | |
|---|---|
| Total users | 8 |
| **Jobs submitted** | **4173** |
| Jobs accepted | 4173 |
| Jobs with good match | 4010 |
| Jobs submitted by JSS | 4007 |
| Jobs run | 3964 |
| **Jobs done** | **3954** |

95% success !!

# IST Demonstration

- **CrossGrid has participated in the World Grid demonstration involving European and US sites from CrossGrid, DataGrid, GriPhyN and PPDG.**

- **It took place in November 2002.**

- **It was the largest grid testbed in the world.**

- **Applications from the CERN/LHC experiments CMS and Atlas were used.**

- **CrossGrid participated with 3 sites:**
  - **LIP** - Lisbon
  - **FZK** - Karlsruhe
  - **IFIC** - Valencia

# Coordination

- Collaborative Work:
  - 17 VRVS meetings
    - keep regular contact, share info
    - quite an effort!
  - Several presential meetings
    - Cracow
    - CERN ( april, july, october)
    - Linz
    - Santiago
- Mailing lists:  *crossgrid-wp4@lists.cesga.es*
- WP4 Web pages
  - *http://grid.ifca.unican.es/crossgrid/wp4*
- First publication (ACROSSGRID Workshop)
- **Integration Team**

*Deliverables used to trigger and organize work*

# Testbed setup

- **Installation of testbed sites and middleware deployment**

- Certification Authorities:

| Country / Institution | CrossGrid | DataGrid |
|---|---|---|
| Poland / PSNC | Deployed and accepted | Accepted in October |
| Netherlands / NIKHEF | Accepted | Already in DataGrid |
| Germany / FZK | Deployed and accepted | Accepted in June |
| Slovakia / IISAS | Deployed and accepted | Accepted in October |
| Ireland /TCD | Accepted | Already in DataGrid |
| Spain / CSIC | Accepted | Already in DataGrid |
| Greece / AUTH | Deployed and accepted | Accepted in October |
| Portugal / LIP | Accepted | Already in DataGrid |
| Cyprus / UCY | Deployed and accepted | Accepted in January |

http://grid.ifca.unican.es/crossgrid/wp4/ca

# Infrastructure Support

## ■ **Software repository**

**http://gridportal.fzk.de**

- Customized GNU Savannah (based on SourceForge )
- CVS browsable repository
- Main current usage:
  - ca. 35 web-visits per day (=1000 hits)
  - 7000 files, 356MB, 850.000 code-lines, 15.000 doc-lines + 174 doc/pdf-files
  - 44 X#-RPMs in the download repository

# Infrastructure Support

- ## HelpDesk

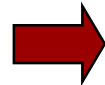  **http://cg1.ific.uv.es/hlpdesk/**

- Question-Answer Mechanism

(follow the evolution of question via tickets)

- Unified knowledge database with EDG

- Interacion levels:
  - User
  - Supporter
  - Administrator

- Based on **OneOrZero v1.4 RC2**
  - distributed under GPL
  - a web based helpdesk system incorporating PHP, MySQL Javascript

# Verification and Quality Control

- **Test and Validation Testbed**

- First Tests of Applications
  - HEP prototype using MPICH-G2

- Support:

  **grid.support@lip.pt**

  **http://www.lip.pt/computing/cg-tv-services**

- Usage Statistics

- Tools:
  - Monitoring (mapcenter)
  - CrossGrid Host Check Tool



http://www.lip.pt/computing/cg-services/site_check

# Planning

WP4

**requirements from**
WP 1,2,3

**Feedback from**
DATAGRID testbed

**Feedback from**
WP 1,2,3

**Feedback mainly from**
WP 1

Integration Team

| Plan | Setup | First testbed | Evolution: Prototype 0 | Support Prototype 1 | FINAL |

3    6    10    15    21    30    33    36

M4.1    M4.2    D4.2    D4.3    M4.3    D4.5    D4.6    D4.7    M4.4

PU    PU    CO    D4.4    CO    CO    CO    PU

D4.1
PU

report on requirements & planning

testbed setup on selected sites

1st prototype release

internal progress report

internal progress report

internal progress report

final testbed

PU

final demo + report

CSIC

*Jesus Marco*    **DataGrid WP6, Barcelona, 12th May 2003**

# Software Integration and Testbed Release

| Setup | First testbed | Evolution: Prototype 0 | |
|---|---|---|---|

**Basic middleware**
Validation testbed

**Integration of CrossGrid software**
Development testbed

**Test and validation**
Validation testbed

**First production release.**

**Deployment**
Production testbed.

Basic middleware
EDG 1.4.3 Globus 2

***CORE WP4 Integration Team***

- Development tools
  - MPI verification
  - Benchmarking
  - Performance prediction
  - Monitoring
- Middleware:
  - RAS, Portal, Migrating Desktop
  - Parallel Interactive Scheduler
  - Monitoring
  - Data Access Optimization
- Application Prototypes

***CrossGrid Integration Team***

- WP2 + WP4 people

- WP3 + WP4 people

- WP1 + WP4 people

# Integration Work in Santiago

## WP2 + WP4

Developer Workstation (On top of UI, RH6.2), first at CESGA

* MARMOT (Bettina, Rafa) RPM? test? Difficulties?
* GRIDBENCH (George, Christos)
* PERFORMANCE PREDICTION (Fran, Carlos+Javier)
* GPM (Roland+Wlodek,Piotr) installed at Munich
* Processing of monitoring data (Adam)

## WP3 + WP4

* RAS+Migrating desktop (Pawel, Marcin)  server(s) at PSNC
* Portal Application Server (Yannis,Angelos,Jesus,Dani,Javier,Javier)
* JSS (Stephano+support from Jorge) JSS server at PSNC (in another machine)
* Modified RB (Alvaro,Santi,Javier) RB server at IFIC, and at CESGA
* SANTA-G (David,Mario) RGMA server at LIP, tcpdump where?
* OCM-G (Roland, Bartosz, Ariel)  machine at CYFRONET?
* Integrating reports for Jiro (Slawek, Marcus), Data Access Optimization (Lukasz,Piotr)

# Integration Work in Santiago

## WP1 + WP4

**HEP prototype work (Jorge, David, Celso ):**

Three types of execution modes: (a) "EDG-like", (b) MPI inside cluster, (c) MPI across sites

- (a) Full chain: portal/migrating desktop+ JSS,   GRAPHICS?
- (b) Submission using modified procedure, could we send from Portal? Graphics?
- (c) Same question

FLOODING CONTROL APPLICATION

- Installation at external cluster started (Jan, Viet, Rafa)

METEO APPLICATION

- 1.4.3 Air pollution: Installation at testbed started (Jose Carlos , Carlos+Javier)
- 1.4.2 Mesoscale + Datamining: Installation at testbed started (Antonio, Rafael,Daniel)
- 1.4.1 Meteo (Bogumil , Michal+ Adam)

BIOMEDICAL APPLICATION

- Installation at cluster started (Alfredo , Dick)

# Work for next months

- Maintain testbed stability:
    - Evolution of production testbed to 1.4.4 these weeks
- **Work on integration, establish the development testbed**
- Installation: test LCFGng and *support clusters*
- Prepare migration to EDG 2 and RH 7.3, *and CERN LCG-1*
- Support the extension to new sites.
    - More sites internal to the project (Linz)
    - Possible external sites and users (policy needed).
- **Study the usage of QoS in CrossGrid**
    - Create a QoS test infrastructure on network and computing resources
- **Start the security group activities**
    - Policies, guidelines, tracking of problems, patches.
- Stress testing of the infrastructure.

# DataGrid / CrossGrid Spanish CA
## *working on improvements*

- Web Access , Unix command access
    - Users: For making requests, getting certificates
    - RAs: To approve/reject requests

- Security:
    - CA is kept offline
    - RAs online: https (use certificates)+ password + code card

- Based on Apache + PHP + MySQL

- Layered structure programming to allow easy modifications.

- To be presented at next CA managers meeting

# Collaboration with DataGrid

- Tracking EDG releases

- Collaboration on:
  - **Helpdesk and support**
  - **Software repository and autobuild**
  - ***Installation and large cluster integration***
  - **Test and validation with the EDG testgroup**
  - ***Network QoS issues***
  - **Participation in Security group (CA)**

- Advice on migration?

# Conclusions

- **The *CrossGrid testbed is operative***
  - Regular tests and use, including direct MPI execution

- **Evolution**
  - Testing and validation for:
    - Applications (WP1)
    - Programming environment (WP2)
    - New services & tools (WP3)
  - Emphasis on interoperability with EU-DataGrid (EDG)
  - Extension of GRID across Europe
  - Advice to follow GT3 while need to follow LCG…
  - to be analyzed!