WP1 activity, achievements and plans

Where we came from, what we did and learned,
how we can put this to good use.

Francesco Prelz
Francesco.Prelz@mi.infn.it

DataGrid is a project funded by the European Commission
under contract IST-2000-25182

3rd EU Review – 19-20/02/2004

Talk Outline

- Objectives of WP1, and how they matched the structure and timeline of the DataGrid project.
- The WP1 workload management solution, and what WP1 delivered over time.
- Lessons learned.
- Plans for the ’present’ and the future.
- Questions. (10’)

WP1 objectives

Or, where we started from...

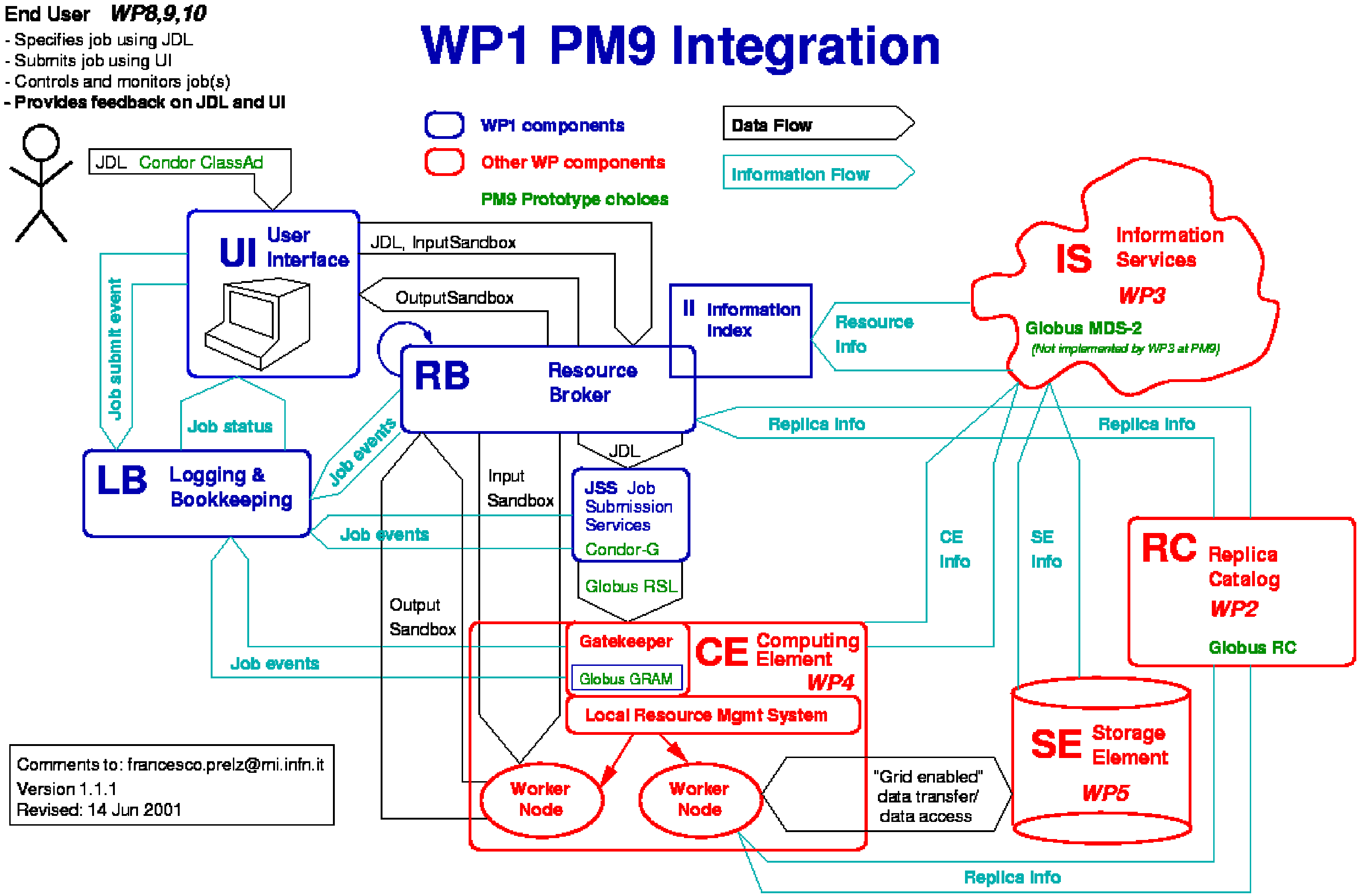
- Task we were given in the TA: "*To define and implement a suitable architecture for distributed scheduling and resource management on a GRID environment".*
  - Real life scientific applications meet 'computer science' grid projects, with mutual benefit.
  - And with the guarantee of a fast-paced three-year schedule.
    - First version of software to be delivered at project month 9, starting from scratch and while bootstrapping a new collaboration.

In other words:

- We found little room for a traditional requirements/architecture/implementation/deployment cycle.
- But this was good to get early user involvement and feedback.

The beginnings of WP1

- A number of products and services that were in existence when the project started were evaluated, and many were adopted.



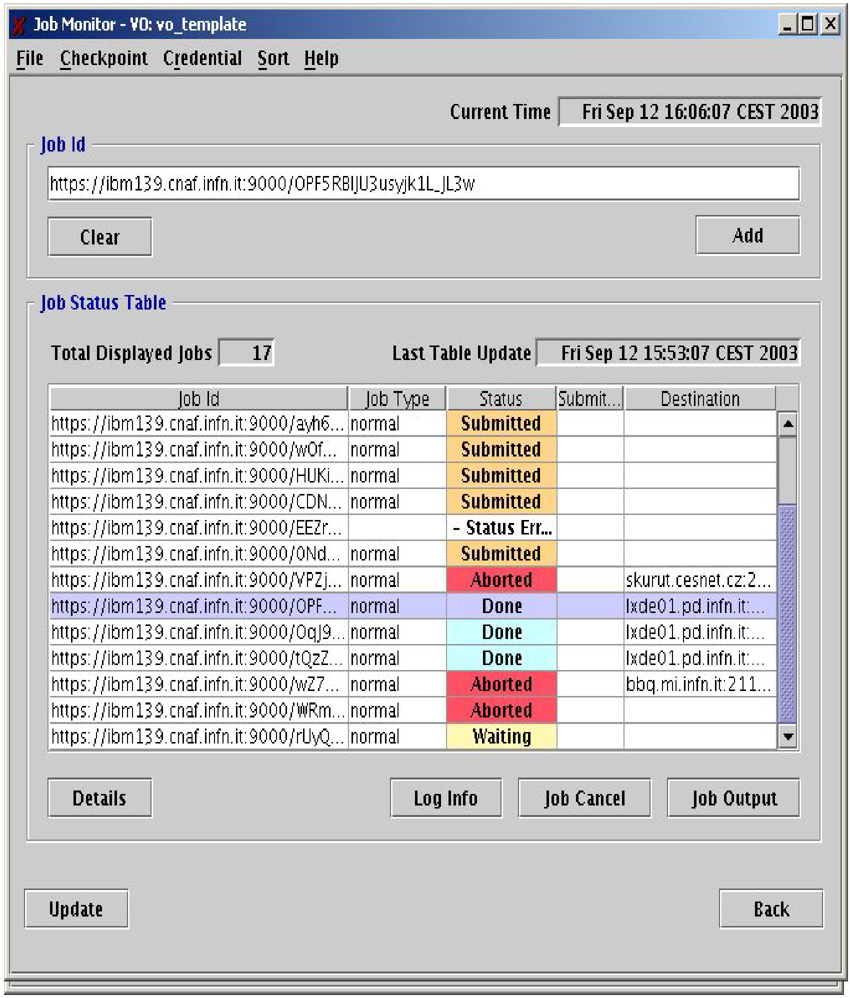
WP1 PM9 Integration

End User *WP8,9,10*
- Specifies job using JDL
- Submits job using UI
- Controls and monitors job(s)
- **Provides feedback on JDL and UI**

Comments to: francesco.prelz@mi.infn.it
Version 1.1.1
Revised: 14 Jun 2001

What did WP1 develop?

- To provide “an integrated workload management system, with distributed scheduling”, we needed to add:
  - A well-defined, as lightweight as reasonably achievable, User Interface, API and GUI.
  - A modular match-making/"brokering" service. Its policies integrate of resource authorisation information (VOMS) and data requirements.
  - Scaffolding around CondorG, the “reliable job submission” component.
  - A Logging and Book-keeping service to build a uniform view of jobs out of information coming from many system components.



Current Time: Fri Sep 12 16:06:07 CEST 2003

Job Id: https://ibm139.cnaf.infn.it:9000/OPF5RBIJU3usyjk1L_JL3w

Job Status Table

Total Displayed Jobs: 17

Last Table Update: Fri Sep 12 15:53:07 CEST 2003

Job Id	Job Type	Status	Submit...	Destination
https://ibm139.cnaf.infn.it:9000/ayh6...	normal	Submitted		
https://ibm139.cnaf.infn.it:9000/wOf...	normal	Submitted		
https://ibm139.cnaf.infn.it:9000/HUKi...	normal	Submitted		
https://ibm139.cnaf.infn.it:9000/CDN...	normal	Submitted		
https://ibm139.cnaf.infn.it:9000/EEZr...		- Status Err...		
https://ibm139.cnaf.infn.it:9000/0Nd...	normal	Submitted		
https://ibm139.cnaf.infn.it:9000/VPZj...	normal	Aborted		skurut.cesnet.cz:2...
https://ibm139.cnaf.infn.it:9000/OPF...	normal	Done		lxde01.pd.infn.it:...
https://ibm139.cnaf.infn.it:9000/OqJ9...	normal	Done		lxde01.pd.infn.it:...
https://ibm139.cnaf.infn.it:9000/tQzZ...	normal	Done		lxde01.pd.infn.it:...
https://ibm139.cnaf.infn.it:9000/wZ7...	normal	Aborted		bbq.mi.infn.it:211...
https://ibm139.cnaf.infn.it:9000/WRm...	normal	Aborted		
https://ibm139.cnaf.infn.it:9000/rUyQ...	normal	Waiting		

The WP1 development cycle

- The first WP1 prototype release was delivered at PM 10.
- It was functional, with the novel ability to deal with data requirements, but soon met a *very* steep scalability barrier.
- Early feedback and troubleshooting in the field were vital in locating the trouble spots (will talk briefly about this process).
- The experience was merged into the design for Release 2.
- Batch, interactive, parallel and checkpointable jobs are supported.
- Release 2 survived tests to the scale of 10000 workload requests a day. The services on an individual RB node are routinely tested with storms of 2000 requests from 20 concurrent users. Each submission takes 3-4 wall seconds.
- The cycle is continuing...

Expectations and reality

- Problems we expected:
  - Service scalability problems, with increasing user and job load.
  - We imagined we would simply hit the resource *roof* on one node, and address this with service configuration.
- Problems where we spent most time:
  - Controlling the direct and indirect interplay of the various integrated components.
  - Addressing stability issues and bottlenecks in a non-linear system.
  - Predicting (or failing to predict) *where* the *next* bottleneck will appear in the job processing network.

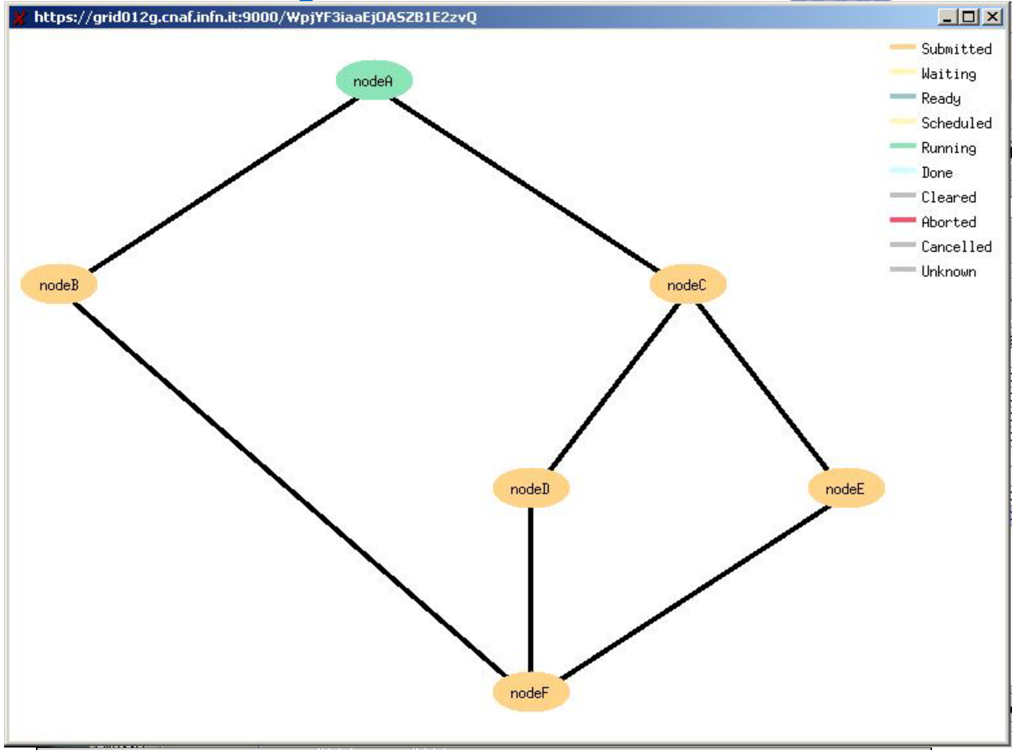
Lessons we learned

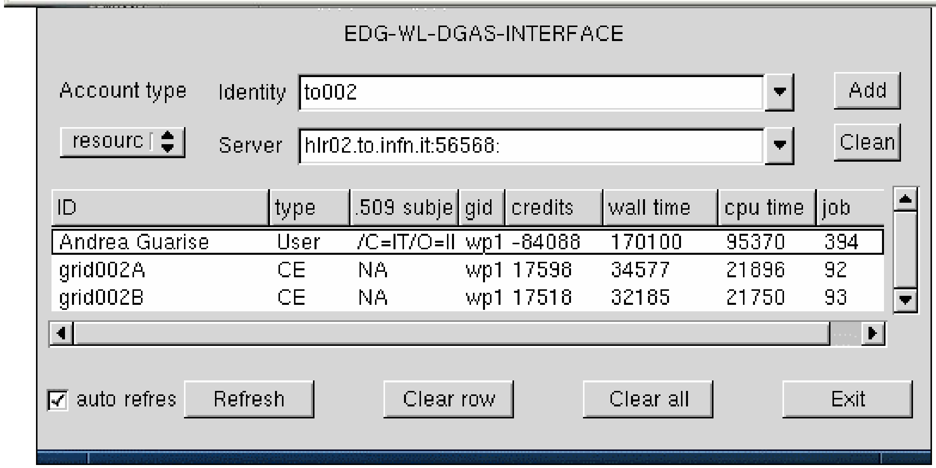
- Many “principles” at the level of implementation:
  - Always apply *reliable,* properly backtraceable communication among services
  - For every component there should be another one ‘taking care’ of it.
  - Monolithic, long-lived processes should be avoided when there are many, complex layers of external dependencies.
  - Etc, etc…: these could be captured for Release 2!
- The effort of integrating together 30+ external packages tends to be minimised.
- A test strategy should appear at the same time as the code.
- To safely process thousands of requests through, the ‘high watermark’ of the system should be in the tens of thousands…

  → Many thanks to our colleagues in the LCG Certification Group.

What else did WP1 develop ?

- Grid accounting infrastructure, based on an economic model (DGAS). This is now deployed on the WP1 testbed, and we are trying to expand the scale of these tests to verify the suitability of the model.
- Support for job dependencies (via DAGman), demonstrated at this review.
- Infrastructure and user API for automatically partitionable jobs.



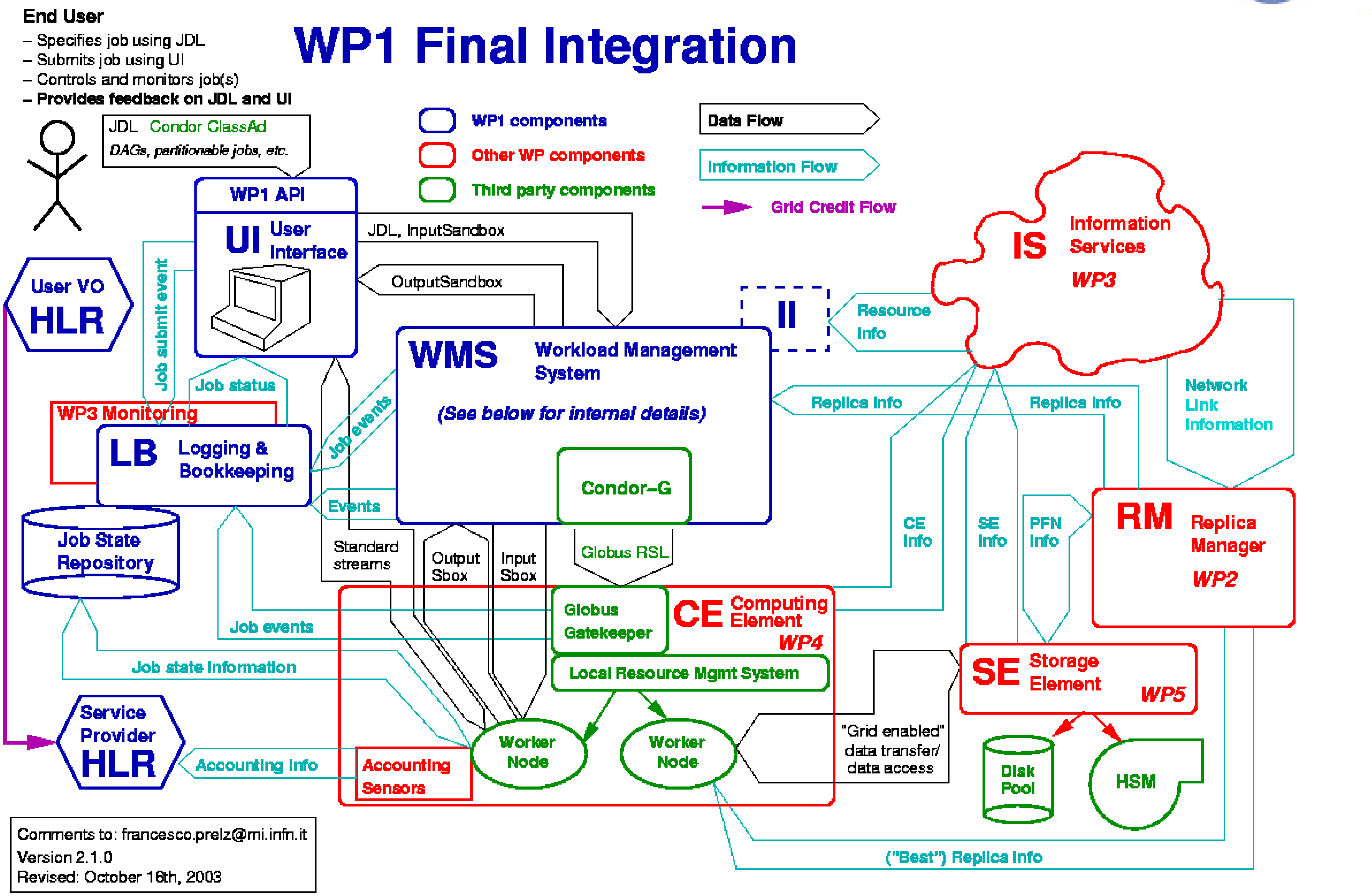

EDG-WL-DGAS-INTERFACE

Account type: resourc
Identity: to002
Server: hlr02.to.infn.it:56568:

ID	type	.509 subje	gid	credits	wall time	cpu time	job
Andrea Guarise	User	/C=IT/O=I	wp1	-84088	170100	95370	394
grid002A	CE	NA	wp1	17598	34577	21896	92
grid002B	CE	NA	wp1	17518	32185	21750	93

☑ auto refres

A much more complex picture…



End User

- Specifies job using JDL
- Submits job using UI
- Controls and monitors job(s)
- **Provides feedback on JDL and UI**

Comments to: francesco.prelz@mi.infn.it
Version 2.1.0
Revised: October 16th, 2003

The bright future...

- LCG, CrossGrid, DataTAG, GridPP and **grid.it** are now using and developing on the WP1 code. We keep supporting them.
- There still are few issues to be addressed to harden the system:
  - Collection/distribution of resource information.
    How do we get to know that a resource is there?.
  - Resource access.
    How do we know that a resource is available now *?*
  - Handling of data movement/"placement".
    How do we move data at the right time?
  - Streamlining of error reporting.
    Why is this still going wrong?
  - System scalability.
    How can I submit this 1 million jobs and keep them together?
- There is also a commitment by basically all partners and staff of WP1 to continue in the context of future projects.

We are happy to take questions!

Any questions ?

Thanks everyone!

- We thank the European Commission for having given us the opportunity for development in this field.
- We acknowledge the support of our funding agencies: INFN, CESNET and PPARC.
- We value very much the cultural exchange and partnership with Datamat Spa, our industrial partner.
- We wish to thank all the colleagues in DataGrid for the professional growth coming from our many interchanges.

Thanks to you all.

A little bibliography

- Home page for the Grid Workload Management workpackage of the DataGrid project: http://www.infn.it/workload-grid.
- Home page for the Condor project http://www.cs.wisc.edu/condor/
- Home page for the Globus project http://www.globus.org/
- EU DataGrid WP1 (G. Avellino *et al.*), "The EU DataGrid Workload Management System: towards the second major release", Talk from the 2003 Computing in High Energy and Nuclear Physics (CHEP03), La Jolla, Ca, USA, March 2003, Get PDF.
- EU DataGrid WP1 (G. Avellino *et al.*), "The first deployment of workload management services on the EU DataGrid Testbed: feedback on design and implementation", Talk from the 2003 Computing in High Energy and Nuclear Physics (CHEP03), La Jolla, Ca, USA, March 2003, Get PDF.