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EuroVO-DCA

The European Virtual Observatory Data Centre Alliance

COORDINATION ACTION

RESEARCH INFRASTRUCTURE

COMMUNICATION NETWORK DEVELOPMENT

D13 – FINAL REPORT ON WP5 ACTIVITIES

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	Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)	
	Dissemination Level	
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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SUMMARY

Work Package 5 of the EuroVO-DCA (WP5) aimed at achieving coordination between the VObs and the computational grid communities. Its main task has been the organisation of a set of activities necessary to allow VObs users to exploit (through the data centres) the processing capabilities offered by the computational Grid projects in European countries, or at the continental level (e.g. EGEE, DEISA).

Four have been the main directions of this activity:

- **Knowledge acquisition –** WP5 made a taxonomy characterising and classifying the approaches used to build Grid infrastructure and applications, highlighting the design and engineering similarities and differences of state-of-the-art in Grid middleware. A Census of the grid initiatives was compiled, with particular attention to the major grid projects; the Census should be considered a living document that should be kept up-to-date also after the project end. A study of grid middleware was performed, with particular reference to authentication and authorization procedures, analysis on data management and job management.

- **Coordination with other Work Packages and other European projects –** WP5 achieved coordination with other initiatives at different levels:

    - EuroVO-DCA WP4 ("Theory in the VObs") by direct participation into the Work Package activities, support to numerical modelling initiatives in WP4 to port codes on the grid, and organisation of back-to-back workshops (in April 2008).

    - VO-TECH DS3, participating in the implementation of prototypes, participating as a contributed non accountable activity.

    - EGEE, through participation in its meetings and user-forums and creation of a Virtual Organization (dca.euro-vo.org); this has led to the creation of an Astronomy and Astrophysics "cluster" funded within EGEE-III which has the task of running applications, possibly VO-aware, on the EGEE infrastructure and identifying requirements to be submitted to the EGEE-III technical bodies for infrastructure upgrade.

    - OGF, for following the evolution of the grid standards.

    - IVOA, through participation in the Grid and Web Services Working Group, and through the relations between IVOA and OGF by means of the Astro-RG Interest Group.

    - Astro-WISE and LoWISE, through direct participation of the NOVA partner.

- **Guidelines –** WP5 prepared a document on single sign-on grid (authentication and authorization), consequently designing a prototype in collaboration with the VO-TECH DS3 and submitting to the IVOA Grid and Web Services Working Group as a specific grid-based implementation of the IVOA authorisation & authentication standard; VObs tools (VOSpace) was used to manage data and move data from and to the grid storage systems.

- **Dissemination –** The major event was the WP5 Euro-VO Computational Grid Workshop (Deliverable 12) dealing with Grid and VObs issues organised in April 2008; oher dissemination activities were also performed in collaboration with EGEE.

1. WP OBJECTIVES AND STARTING POINT OF WORK AT THE BEGINNING OF THE PROJECT

1.1. WP activities and objectives

The purpose of WP5 was achieving coordination between the VObs and the computational grid communities. WP5 has been organising the activities necessary to allow VObs users to exploit (through the data centres involved in the project) the processing capabilities offered by the computational Grid projects available in the countries participating in this proposal, or at the European level (e.g. EGEE, DEISA).

1.1.1. Knowledge acquisition

A) There are a number of different grid initiatives in Europe. Some of them are focused on development of grid middleware, some on the use of pre-existing grid infrastructures to run scientific/industrial applications. WP5 made a survey of all the European Grid projects, both at the National and European scale; some "local" Grids at the campus or metropolitan level have also been taken into account.

B) Grid computing is essentially distributed computing over wide-area networks that involves large scale resource sharing, selection and aggregation. The grid middleware is the software that underlines the fundamental Grid services: information services, resource discovery and monitoring, job submission and management, brokering and data management. WP5 identified four main services which are components of any grid middleware:

- Authentication and Authorization service
- Data management service
- Job management service
- Information system

To ease the data centres access to Grid infrastructures, WP5 gathered information on the different mechanisms to interact with those services.

1.1.2. Coordination with other Work Packages and other European projects

Particular attention has been given to the Grid core projects and initiatives. The main European grid project is Enabling Grids for E-sciencE (EGEE) , both for its relevance in the European Community, and for the number of computational/storage resources and institutions involved. The EGEE project aims to provide researchers in academia and industry with access to major computing resources, independent of their geographic location. It has been developed through three phases, separately funded by EU/FP. EGEE-II was active at the time of the EuroVO-DCA kickoff; during the project, EGEE-II ended and EGEE-III started.

The EGEE objective is to build a consistent, robust and secure Grid network that will attract additional computing resources and to continuously improve and maintain the middleware in order to deliver a reliable service to users. WP5 monitored the EGEE project activities and concentrated on interoperability issues between Euro-VO and EGEE.

WP5 closely followed the evolution of Grid standards through the Open Grid Forum (also known as GGF). The Open Grid Forum is a community of users, developers, and vendors leading the global standardization effort for grid computing. The work of OGF is carried out through community-initiated working groups, which develop standards and specifications in cooperation with other leading standards organizations, software vendors, and users. WP5 emphasized the use of those standards by the different grid initiatives. Moreover, WP5 identified any tool/service widely used / adopted and emerging as a de-facto standard.

Due to the particular nature of this WP, it was important to interact as much as possible with other Work Packages of EuroVO-DCA. In particular, WP4 ("Theory in the Virtual Observatory") is WP5 natural counterpart, because of its need for computational facilities.

Another project relevant to WP5 activities was the VO-TECH FP6 Design Study, which aims to complete the technical preparation for the construction of the European Virtual Observatory. The VO-TECH project undertakes feasibility studies and design work aimed at integrating new technologies into the Euro-VO. Key IT advances to build upon are in intelligent resource discovery (ontology and the semantic web), data mining, and visualisation capabilities. In particular, WP5 has worked to build a strong interaction with the Design Study 3, *New Infrastructure*, of the VO-TECH. DS3 is in charge of designing mature infrastructure components for Euro-VO and to ensure interoperability and international integration (including liaison with EGEE). It is to be noted that the above-mentioned IT technology developed, including access to the latest distributed grid computing services, is being integrated within global astronomical interoperability standards in the framework of the FP7-funded EuroVO-AIDA project.

1.1.3. Guidelines

One of the main aspects of the WP5 work was to suggest how data centres can interoperate with local/European grid initiatives. For this reason, one of the WP5 activities was to provide manuals for the data centres that describe access procedures in grid facilities and the way to use them for their computational or storage requirements. The documents have been created and distributed using the EuroVO-DCA twiki page and precisely in the section related to WP5.

1.1.4. Dissemination

To make the Data centres aware of the different possible interactions with the Grid infrastructures, WP5 had to set up an efficient dissemination activity. This activity is based both on the organization of a Grid Workshop for Astronomical data centres, in collaboration with the Grid projects, and on identifying any grid school/documents organized/produced by the Grid projects.

As the Grid Information is not always well organized and easy to access, WP5 provided an easily available information repository for the data centres and for the Astronomers to recover any information they need. The repository collects links to the documents and any relevant contact person useful to the data centres (ex. VOrg managers, support teams etc.). The repository is identified in the WP5 section of the EuroVO-DCA twiki page.

The dissemination activity involved also the grid community that must be aware of the requirements of the Astronomical data centres in order to make the grid environment more suitable to the data centres needs. WP5 verified that the requirements identified by the data centres are taken into account by the different Grid Projects.

1.2. List of deliverables

Del. no.	Deliverable name	WP no.	Date due	Actual/ Forecast delivery date	Estimated indicative person-months	Lead contractor
D12	Euro-VO Computational Grids Workshop	5	January 2008	9th – 11th April 2008	17	INAF
D13	Final Report on WP5 activities	5	October 2008	15th December 2008	9	INAF

1.3. List of milestones

Milestone no.	Milestone name	WP no.	Date due	Actual/Forecast delivery date	Lead contractor
1	PCT meeting	5	April 2007	3rd & 4th May 2007	CNRS
2	PCT meeting	5	October 2007	4th & 5th October 2007	CNRS
3	Mid-term Board meeting	5	October 2007	4th & 5th October 2007	CNRS
4	Euro-VO Computational Grid Workshop (D12)	5	January 2008	9th – 11th April 2008	INAF
5	PCT meeting	5	April 2008	29th May 2008	CNRS
6	PCT meeting (held together with the final Board meeting)	5	October 2008	19th & 20th November 2008	CNRS

2. PROGRESS TOWARDS OBJECTIVES

2.1. Knowledge acquisition

Survey of the grid infrastructures: as a grid infrastructure is strongly dependent on the middleware used, WP5 made a taxonomy that characterises and classified various approaches used to build Grid infrastructure and applications. The taxonomy not only highlights the design and engineering similarities and differences of state-of-the-art in Grid middleware, but also identifies the areas that need further research. As part of this activity, a Census of the grid initiatives was compiled by WP5 with particular attention to the major grid projects. The focus of the Census was:

- To identify the grid projects and the middleware used
- To identify the projects that actually provide a production grid environment
- To verify the middleware tools and identify those useful for EuroVO-DCA data centres
- To check their interaction with main European grid initiatives (EGEE, DEISA etc.)
- To check the compliance with the standards proposed by OGF

The Census is available for download from the EuroVO-DCA WP5 TWiki page (http://cds.u-strasbg.fr/twikiDCA/bin/view/EuroVODCA/WP5Grid). For the particular nature of the grid initiatives and due to the continuous evolution of the grid standards and tools, WP5 considers the Census a living document that has been upgraded during the Work Package activity and will be kept up-to-date also after the project end.

Grid Middleware: the study of the grid middleware performed during Cycle 1 was necessary to clarify how to access the different services offered by the computational Grids. Actually, those services regard mainly data storage/sharing and job execution mechanisms (work load management and work flow management).

A primary WP5 analysis focused on authentication and authorization procedures and their relation with the proposed IVOA Single-Sign-On mechanisms. This analysis has been formalised in a document on Single Sign On procedures that is available for download from the WP5 TWiki page.

Analysis on data management and job management has also been made, and is reported in the following section.

2.2. Coordination with other Work Packages and other European projects

Coordination with WP4 of the EuroVO-DCA has been achieved by direct participation into the Work Packages activities: the WP4 coordinator has been an active member of WP5, and the WP5 coordinator has been an active member of WP4. Moreover, WP4 and WP5 co-ordinated the organisation of their Workshops (D10 and D12 respectively), which have been held in the same place, one following the other. In this way it has been possible to cover and discuss during the Workshops several aspects related to the interaction of the two Work Packages, such as the use of the Grid for massive numerical calculations for theoretical studies.

From the more practical point of view, support was given to a WP4 initiative in the field of numerical modelling to port their codes on the EGEE grid. The exercise was useful to allow understanding the interactions between the request for theory data by using VO-compliant query mechanisms, and their production if they are not available; this is performed by the Data Centre on behalf of the user requesting the simulations, possibly using the Grid infrastructure through specific "project" authentication mechanisms.

As regards EGEE, WP5 took part to its meetings and user-forums. Work has been done to create a Virtual Organization within the EGEE infrastructure, in order to allow the data centres to use the EGEE resources. This Virtual Organization is called "dca.euro-vo.org". The Virtual Organization Membership Service (VOMS) server has been setup by ESAC. The VOMS is a system for managing authorization data within a Virtual Organization. The Virtual Organization server is hosted by ESAC.

The key result in the collaboration with EGEE has been the creation of an Astronomy and Astrophysics "cluster" funded within EGEE-III. This section of the project has the task of running applications, possibly VO-aware, on the EGEE infrastructure and identifying requirements to be submitted to the EGEE-III technical bodies for infrastructure upgrade.

WP5 followed the evolution of the grid standards through participation in OGF activities. The coordination activity with the Grid initiatives has also the goal of verifying that requirements from the VObs community are taken in the appropriate consideration by the individual computational Grid projects, as in the EGEE-III case (see above).

To enforce the coordination and collaboration with the VO-TECH project WP5 staff has actively participated in VO-TECH DS3 as a contributed non accountable activity. WP5 took part in the VO-TECH meetings.

The interaction with IVOA has been reached by participating in the Grid and Web Services Working Group, and through the relations between IVOA and OGF by means of the Astro-RG Interest Group.

WP5, with the direct participation of NOVA, achieved coordination with two other large scale astronomical data storage and processing systems: Astro-WISE (an information system for wide -field astronomy, funded by EU/FP) and LOFAR Long Term Archive storage system (LoWISE). Both systems have similar tasks in the accessing grid infrastructure both for computations and data storage and publishing data in Virtual Observatory.

2.3. Guidelines

On the basis of the analysis done of the Grid middleware and on the basis of the collaborations organized with the European Grid initiatives, WP5 prepared a document regarding the single sign-on grid technologies, as explained above. This document collects the standards for authentication and authorization of both users and services and some recommendations for the data centres. The recommendations proposed in this document have been used to design a prototype of authentication and authorization delegation service. This prototype has been done in collaboration with the VO-TECH DS3 and has been submitted to the IVOA Grid and Web Services Working Group as a specific grid-based implementation of the IVOA authorisation & authentication standard.

To allow the gathering of information and the preparation of guidelines and documents to be practical and experience-based, some of the partners participating in WP5 have performed the integration of pilot applications on the Grid. In particular, data centres can port applications (data processing, cross-matching, simulations) on the local/national Grid infrastructure they can access, and/or on EGEE.

A test bed WP5 setup on the EGEE-III infrastructure has been used to test those pilot applications. Beside the test applications proposed by the data centres, WP5 has tested two different kinds of applications: a data oriented application and a theoretical application. The data oriented application uses VObs tools to manage data (the VOSpace) and moves data from and to the grid storage system. The theoretical application uses the computational capabilities of the Grid environment to make numerical simulations and stores the results on the Grid storage system. The results are also "registered" in the VObs data management system to make them accessible to the VObs users.
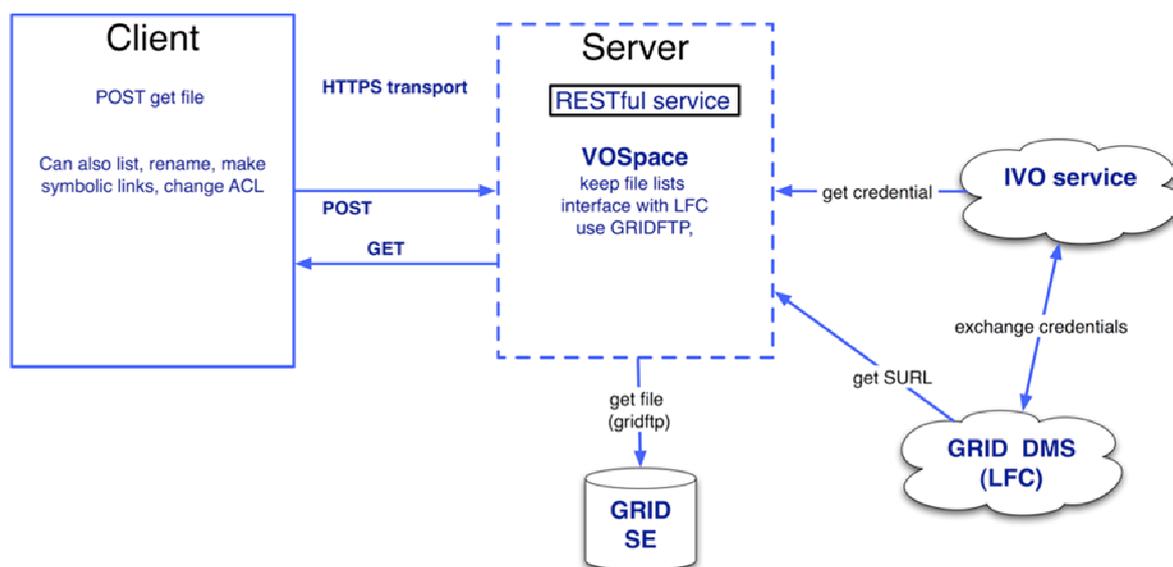

Figure 1 TheVOSpace LFC integration using the Delegation Service

As regards the data oriented application, we were not able to make a complete test due to the fact that the VOSpace IVOA standard did not support a grid compliant authentication system. We then actively worked with the IVOA Grid and Web Services working group to design and implement a credential delegation service that can be used to delegate user credential to the VOSpace server. The Credential Delegation Protocol specification is now on the RFC phase within IVOA. We make the design of the final implementation as shown in figure 1; the test implementation was performed in the framework of the VO-TECH DS3 Work Package.

We expect to have one single VOSpace that allow accessing the whole grid file system.

2.4. Dissemination

A major event for WP5 and EuroVO-DCA was the WP5 Euro-VO Computational Grid Workshop (Deliverable 12) dealing with Grid and VObs issues organised in April 2008. Other dissemination activities were also performed in collaboration with EGEE, in the framework of the NA3 Work Packages of both EGEE-II and EGEE-III projects, both funded by EU/FP.

WP5 set up an agreement with EGEE-III NA4 and NA3 Work Packages. NA4 focuses on the identification and support of early-user and established applications for use on the EGEE infrastructure, and NA3 focuses on training and dissemination. On the basis of this agreement, data centres can participate to the EGEE-III training events and/or request a

specific one. Moreover, data centres have full access to EGEE-III support. We regularly update the information of the training and dissemination events of EGEE-III to allow Data centers to participate.

The "**Euro-VO – Computational Grids Workshop**", organized by EuroVO-DCA WP5, was held at the Max-Planck-Institut für extraterrestrische Physik (MPE) in Garching bei Munchen, Germany, on April 9-11, 2008. This Workshop was held back-to-back with the "Euro-VO Theory Workshop", organized by EuroVO-DCA WP4.
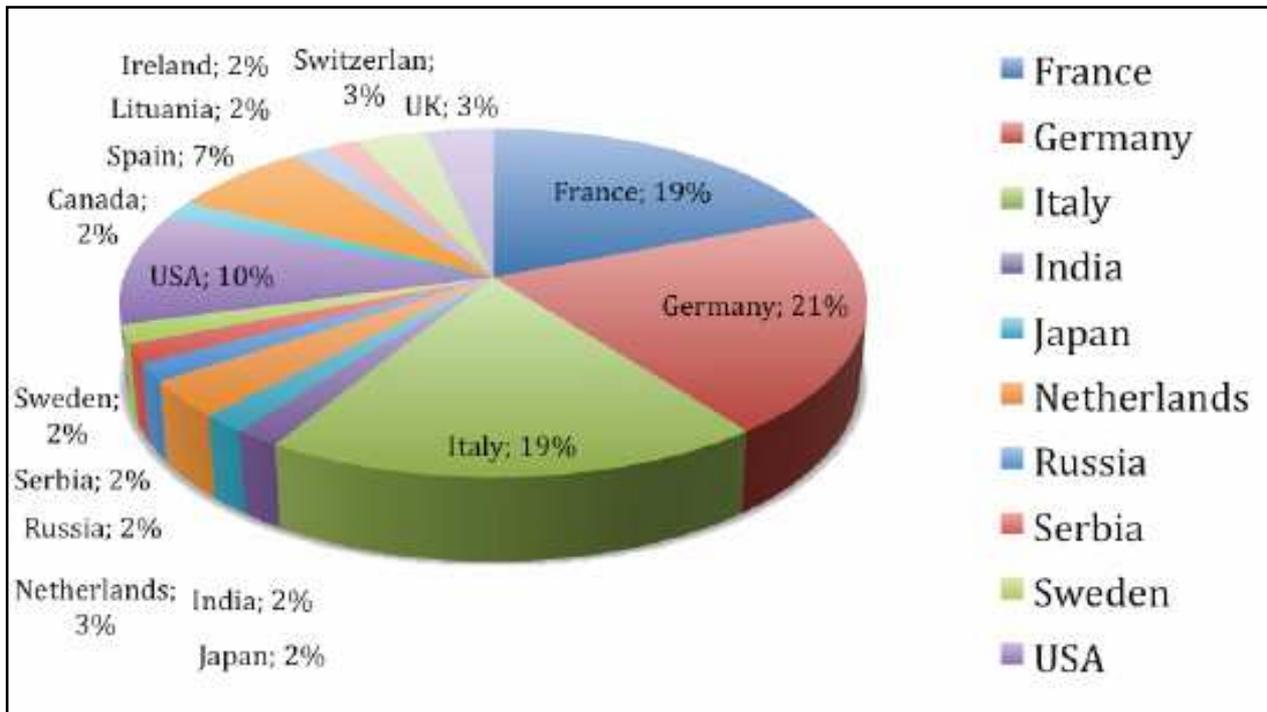
Initially scheduled for January 2008, the "**Euro-VO – Computational Grids Workshop**" was postponed to April 2008. The main reason for the change in date was that the EGEE-II project had expired at the original foreseen date for the Workshop and we had to wait for the Astronomical cluster in EGEE-III to be set up to make it possible for astronomers to have support from EGEE-III via the cluster. The cluster setup and usage has been an important issue addressed during the Workshop.

The main goal of the workshop was to contribute to the integration of the Virtual Observatory and Grid e-science infrastructures and to the development of new Grid-aware astronomical applications. This workshop aimed at contributing to the adoption of Grid and Virtual Observatory technologies by the Astronomical Data Centers.

The Workshop had two main rationales: the Virtual Observatory (VObs) is rapidly evolving as a fundamental tool for the astronomical community; it may be seen as a Grid of federated astronomical databases. The VObs allows global electronic access to the available astronomical data archives of space and ground-based observatories and to simulation databases as well. It also aims at enabling data analysis techniques through world-wide network access, state-of-the-art analysis tools, and a coordinating entity that provides common standards. To process the huge amount of data residing in the VObs it is necessary to provide adequate resources.

On the other hand, Grid infrastructures are deployed with high investments in this kind of facilities, both at the national and European levels. This provides a geographically distributed e-infrastructure available to European scientists. Actually some astrophysical applications, mainly in the theoretical and modeling fields, are already making use of the computing power the computational Grid is able to offer.

The workshop aimed at building the bridge between the VObs and the standard Grid infrastructures, making developers from the different fields meet and exchange experiences and solutions.

To achieve its goals the workshop has targeted two main audiences:

- The first is the community of Grid and VObs developers that contribute to the suite of standard facilities and web services of the VObs and Grid middleware and tools.

- The second audience comprises Grid and VObs users. This includes current and potential users both in the astronomical community and in other scientific areas. A particular goal has been to identify and then support those who are willing to do pilot work using the new tools provided both by the VObs and Grid technologies to work on a specific scientific problem.

The Workshop topics were Current Research advances in Grid and Virtual Observatory systems, European and National e-Infrastructures, Applications in Astronomy and other scientific fields, Data Centres experiences, Data and Databases virtualization in e-science infrastructures and Interoperability and long term sustainability.

The Workshop website is available at: http://www.si.inaf.it/eurovow2008/index.htm, and a Workshop TWiki page including abstracts of the talks and presentations is available at: http://cds.u-strasbg.fr/twikiDCA/bin/view/EuroVODCA/Wp5Workshop.

A total of 55 participants attended to the Workshop.

Here is the list of invited speakers:

Edwin VALENTIJN (NOVA)	Masatoshi OHISHI (NAO Japan)	Mattias STEINMETZ (AstroGrid-D)
Erwin LAURE (CERN, EGEE)	Guy RIXON (AstroGrid)	Franck CAPELLO (Grid5k)
Charles LOOMIS (EGEE, CNRF)	Ruben ALVAREZ TIMON (ESAC)	Giuseppe LONGO (Univ. Federico II)
Claudio GHELLER (Cineca, DEISA)	Luigi FUSCO (ESRIN)	Franck LE PETIT (Observatoire de Paris)
Françoise GENOVA (EuroVO, CDS)	Claudio VUERLI (EGEE Astro Cluster)	Richard HOOK (ESO)
Ugo BECCIANI (COMETA, Italy)	Fabio PASIAN (IGI)	

Concertation aspects:

- With other VO projects and the International Virtual Observatory Alliance (IVOA)
  - D. DE YOUNG (IVOA Chair)
  - M. OHISHI (Japan VO and IVOA Astro-RG Interest Group Chair - Relations with OGF)

- With other EC- funded projects
  - EGEE: C. LOOMIS, E. LAURE
  - DEISA: C. GHELLER
  - Baltic Grid: G. TAUTVAISIENE
  - GENESI-DR: L. FUSCO
  - VO-TECH FP6 Design Study: K. BENSON, G. RIXON, A. SCHAAFF

- With national Grid projects
  - France: Grid 5k
  - Germany: D-Grid and AstroGrid-D
  - Italy: IGI
  - The Netherlands
  - Spain

The proceedings of the workshop are being published by the Supplements of the Journal of the Italian Astronomical Society. The book will be available on line and linked to ADS. The book will be published at the end of this year.

2.5. Meetings in the frame of WP5

The networking aspects of the WP have been particularly important. Besides TWiki pages and teleconferences, also a number of face-to-face meetings have been organised with various community groups to gather information and requirements, spread knowledge, suggest best practices in Grid-VObs integration, coordinate common activities, etc.

In the following, the list of meetings or events within the scope of WP5 in which EuroVO-DCA members participated.

Project

- WP5 Kick Off meeting, Trieste, Italy, 30th November – 1st December 2006.
  http://cds.u-strasbg.fr/twikiDCA/bin/view/EuroVODCA/KickOff

- VO-TECH Stage 5 Planning meeting, Garching, 12th - 15th March 2007 (G. TAFFONI)
  http://wiki.eurovotech.org/twiki/bin/view/VOTech/StageFivePlanningMeetings

- "Euro-VO – Theory Workshop" and "Euro-VO – Computational Grids Workshop", Garching bei Muenchen, Germany, 7th-11th April 2008 (ALL involved)
  http://cds.u-strasbg.fr/twikiDCA/bin/view/EuroVODCA/Wp5Workshop

OGF

- 19th Open Grid Forum, Chapel Hill, USA, 29th January – 2nd February 2007 (C. VUERLI)
  http://www.ogf.org/OGF19/events_ogf19.php

- 20th Open Grid Forum - OGF20/EGEE 2nd User Forum, Manchester, United Kingdom, 7th - 11th May 2007 (G. TAFFONI, C. VUERLI)
  http://www.ogf.org/OGF20/events_ogf20.php

- 23rd Open Grid Forum - OGF23, Barcelona, Spain, 2nd - 6th June 2008 (G. TAFFONI, F. GENOVA)
  http://www.ogf.org/OGF23/

EGEE

- EGEE 2nd User Forum, Manchester, UK, 7th-11th May 2007
  http://egee-intranet.web.cern.ch/egee-intranet/User-Forum/

- EGEE'07 Conference, Budapest, Hungary, 1st - 5th October 2007 (C. VUERLI)
  http://egee2.eu-egee.org/egee_events/conference

- EGEE 3rd User Forum, Clermont-Ferrand, France, 11th - 14th February 2008 (G. TAFFONI, C. VUERLI)
  http://egee2.eu-egee.org/egee_events/userforum/3-user-forum/

- EGEE'07 Conference, Istanbul, Turkey, 22nd - 26th September 2008 (G. TAFFONI, C. VUERLI)
  http://egee08.eu-egee.org/

IVOA

- IVOA Interoperability Workshop, Beijing, China, 12th - 19th May 2007, Astro-RG session (F.PASIAN, G.RIXON, N.WALTON)
  http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/InterOpMay2007Astro-RG

- Astronomical Data Analysis Software and Systems XVII, London, UK, 23rd - 26th September 2007, Astro-RG session (F.PASIAN, G.TAFFONI, C.VUERLI, C.ARVISET, F.CHEREAU, A.MICOL, E. OJERO-PASCUAL, P.OSUNA)
  http://www.adass.org:8080/Conferences/2007/Venue/

- IVOA Interoperability Workshop, Cambridge, UK, 27th - 28th September 2007, (F.PASIAN, G.TAFFONI, C.VUERLI, G.RIXON, , P.OSUNA)
  http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/InterOpSep2007

- IVOA Technical Coordination Group teleconference, 27th February 2008 (F. PASIAN, C. ARVISET)

- IVOA Interoperability Workshop, Trieste, Italy, 18th - 23rd May 2008, Astro-RG/GWS session (F.PASIAN, G.TAFFONI, C.VUERLI)
  http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/InterOpMay2007Astro-RG
  and
  http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/InterOpMay2008GridAndWebServices

- IVOA Interoperability Workshop, Baltimore, USA, 26th - 31st October 2008, (F.PASIAN, G.RIXON, N.WALTON, C.ARVISET, P.OSUNA)
  http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/InterOpOct2008

Communities support

- Vobs.it Workshop, Monte Porzio, Italy, 23rd - 24th November 2006, (P. PADOVANI, F. PASIAN, invited presentations, G. TAFFONI)
  http://vobs.astro.it/index.php?option=com_content&task=view&id=17&Itemid=51

- AS OV First meeting of the Grid Working Group, Lyon, France, 9th January 2007 (G. TAFFONI)
  http://www.france-vo.org/twiki/bin/view/GROUPEStravail/Grids

- "Computational Astrophysics in Italy: results and perspectives" , Rome, Italy, 12th March 2008, (F.PASIAN, G.TAFFONI, C.VUERLI)
  http://www.si.inaf.it/workshop_hpc-grid/

Schools and Courses

- 2nd GRID User Tutorial jointly organized by INAF-SI and Planck WG8, Trieste, Italy, 26th February - 2nd March 2007 (G. TAFFONI, G. LA ROCCA)
  http://wwwas.oats.inaf.it/grid/index.php?option=com_content&task=view&id=82&Itemid=107

- Course for Grid site administrators, Trieste, Italy, 24th -28th November 2008 (G.TAFFONI)

- Course Grid-EGEE tutorial, Paris Observatory, 10th-11th December 2008 (G.TAFFONI)

Cross-fertilisation with other disciplines

- 2nd GRID & e-Collaboration Workshop for the Earth Science and the Space Community, Frascati, Italy, 11th – 12th December 2006 (F. GENOVA, invited contribution; F. PASIAN, invited presentation of WP5)

- ICTP Workshop on Scientific Instruments and Sensors in the Grid, Trieste, Italy, 23rd - 27th March 2007 (G. TAFFONI)
  http://cdsagenda5.ictp.trieste.it/full_display.php?ida=a06290

- Biomed GRID School, Varenna, Italy, 14th – 19th May 2007 (G. TAFFONI)
  http://www.bioinfogrid.eu/course/biomedgrid2007/programme/courses

- ETSI Standardisation Meeting for EU Projects, Sophia Antipolis, France, 4th - 5th December 2007 (F.GENOVA, F.PASIAN)

- 3rd GRID & e-Collaboration Workshop for the Earth Science Community, Frascati, Italy, 16th – 17th January 2008 (F.GENOVA)
  http://www.congrex.nl/07c29/start.asp

3. DEVIATION FROM THE WORKPROGRAMME AND CORRECTIVE ACTIONS

The only deviation from the project plan regards the date of Deliverable D12 (Euro-VO – Computational Grids Workshop). Initially scheduled in January 2008, it was decided to postpone it to April 2008. The main reason for the change in date from WP5 point of view is that for that date the Astronomical cluster in EGEE-III was set up and it was therefore possible for astronomers to have support from EGEE-III via the cluster. The cluster setup and usage has been an important issue to address during the Workshop

ACRONYM LIST

ACL	Access Control List
ADS	Astronomical Data System
AS OV	Action Spécifique Observatoires Virtuels - France
AstroGrid	UK VO project
Astrogrid-D	German Grid for Astronomy project
Astro-RG	Astro Research Group (within OGF and IVOA)
Astro-WISE	Astro Wide-field Imaging System for Europe
CDS	Centre de Données astronomiques de Strasbourg
CERN	European Organisation for Nuclear Research
Cineca	Italian Consortium for Supercomputing
CNRS	Centre National de la Recherche Scientifique
COMETA	COnsorzio Multi-Ente per le Tecnologie di calcolo Avanzato
D#	Deliverable number
DCA	Data Centre Alliance
DEISA	Distributed European Infrastructure for Supercomputing Applications (EC-funded project)
DS#	Design Study number (VO-TECH project)
EC	European Commission
EGEE	Enabling Grids for E-science in Europe (EC-funded project)
ESA	European Space Agency
ESAC	European Space Astronomy Centre, Villafranca del Castillo
ESO	European Southern Observatory
ESRIN	European Space Research Institute, the ESA Centre for Earth Observation
EU	European Union
Euro-VO	European Virtual Observatory
EuroVO-DCA	Euro-VO Data Centre Alliance (EC Funded, eInfrastructure Communication Network Development)
FP#	Framework Programme number
GENESI-DR	Ground European Network for Earth Science Interoperations - Digital Repositories
GGF	Global Grid Forum
GRID SE	Grid Storage Element
GRID DMS	Grid Data Management System
GRID FTP	GridFTP is a transport protocol designed by the Global Grid Forum
GWS	Grid & Web Services
HTTPS	Hypertext Transfer Protocol over Secure Socket Layer
ICTP	International Centre for Theoretical Physics

IGI	Italian Grid Initiative
INAF	Instituto Nazionale di Astrofisica
INAF-SI	Instituto Nazionale di Astrofisica – Information Systems unit
IT	Information Technologies
IVO	International Virtual Observatory
IVOA	International Virtual Observatory Alliance
LCG	LHC Computing Grid
LFC	LCG File Catalog
LHC	Large Hadron Collider
LOFAR	LOw Frequency Array
LoWISE	LOFAR Long Term Archive storage system
MPE	Max Plank institute for Extraterrestrial physics
NA#	Networking Activity number
NAO	National Astronomical Observatory
NOVA	Nederlandse Onderzoekschool Voor Astronomie
OGF	Open Grid Forum
PCT	Project Coordination Team
REST	Representational State Transfer
RESTful	Systems which follow Fielding's REST principles are often reffered to as "RESTful"
RFC	Request For Comments (phase in definition of IVOA standards)
SURL	Software Usability Research Laboratory
TARGET	interdisciplinary working group for new technologies for data storage and processing
UK	United Kingdom
USA	United States of America
VObs or VO	Virtual Observatory
VOMS	Virtual Organization Membership Service
VOSpace	VObs-compliant user storage area
VO-TECH	The European Virtual Observatory - VO Technology Centre (EC-funded project, Infrastructure Design Study, 2005-2008)
WG	Working Group
WP#	Work Package number