COMBINATION OF COLLABORATIVE PROJECT AND COORDINATION AND SUPPORT ACTION

Integrated Infrastructures Initiative project (I3) proposal Infrastructures Call 1

FP7-INFRASTRUCTURES-2007-1

Access to Grids ENables Astronomical research

AGENA

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Participant no. *	Participant organisation name	Part. short name	Country
1 (Coordinator)	Istituto Nazionale di Astrofisica	INAF	Italy
2	Istituto Nazionale di Fisica Nucleare	INFN	Italy
3	Astrophysical Institute Potsdam (representing Astrogrid-D)	AIP	Germany
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5	University of Cambridge (representing AstroGrid)	UCAM	United Kingdom
6	Centre National de Recherche Scientifique	CNRS	France
7	Consejo Superior de Investigaciones Científicas	CSIC	Spain

* *Please use the same participant numbering as that used in Section A2 of the administrative forms*

Work programme topics addressed

INFRA-2007-1.2.2: Deployment of e-Infrastructures for scientific communities

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Proposal abstract

Astronomy is now facing significant data and computational challenges, both observational and theoretical. Many new telescopes and detectors are becoming available to observe the sky at all wavelengths and are producing huge volumes of data, with the challenge to analyse and interpret the data from many different sources. Simulations of the universe are becoming much more sophisticated, as we seek to understand the physical processes underpinning the cosmos. Astronomy is now reaching the point at which scientific progress is being impeded by limitations in the availability of large scale computational power. Through this proposal AGENA will deliver the technology, systems, training and service to the European astronomy community to meet their needs for access to the large scale data and capacity computing resources. AGENA will build upon the existing EU e-Infrastructure.

The key AGENA project goals are to:

- create a flexible and rich interface to the EU computational infrastructure which interoperates both to the astronomy virtual observatory data and analysis network, and to astronomy projects data reduction pipelines
- provide a training and support service for this e-Infrastructure within and outside the consortium (with particular attention to new EU member states and candidate countries) to foster exploitation by the community with the deployment of further applications
- coordinate the key groups active in astronomical research, who have begun to implement the Grid paradigm for their computational needs, and build upon their knowledge
- liaise with the key projects in Europe related to astronomy, astrophysics and cosmology (e.g. ELT, SKA) to support their capacity computing needs through the use of the Grid
- improve the access interfaces and grid middleware through coordination with the Grid projects (e.g. EGEE), to meet the specific requirements of the astronomical community and conversely to expand the capabilities of the Grid infrastructure itself.

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Proposal

Section 1: Scientific and/or technological excellence, relevant to the topics addressed by the call

1.1 Concept and objectives

1.1.1 Concepts and their relevance to the topics of the call

This proposal aims at coordinating, supporting and enhancing the activity of the European astronomical community in the field of Grids. The concept underlying this proposal is to expand the use in the astronomical community of the grid e-Infrastructure (in particular, EGEE and its standards), and at the same time to foster their adoption by the largest possible number of scientists. Access to capacity computing facilities is expected to enhance the throughput in the production of scientific results will be beneficial for the development of science. Furthermore, the European astronomy community will be better placed to maintain its scientific leadership, and have the capacity to fully leverage the significant investment in large new astronomical facilities such as ESO's VLT, the future Extremely Large Telescope (ELT) and the Square Kilo-meter Array (SKA).

These objectives will be achieved by taking a three stranded approach. The first is support, both for the groups having already implemented at some level the Grid paradigm for their computational needs, and for new users. The second is research, extending the capabilities of the Grid by addressing the needs of the community and modifying/adapting the Grid middleware to cope with new requirements. All of this will be done inside one or more “virtual organisations”, coordinated within a coherent framework capable of capturing differences, enhancing commonalities and fostering interoperability across several different types of astronomical applications: this coordination aspect is the third side of the project. This approach, by allowing the sharing of experiences among different teams and the feedback to novice users in terms of support, will ensure the optimisation of the resources invested, both in terms of hardware/software and personnel.

On one side, the activity to be performed in this project will allow to reinforce the impact, adoption and global relevance of the Grid e-Infrastructure (in particular EGEE) within the astronomical community. At the same time, the community of new users will follow new paradigms for Grid access, and this is going to require the adaptation and upgrade of the middleware layer to fully exploit the capabilities of the e-Infrastructure. The resulting expansion and enhancements in the capabilities of the Grid infrastructure, obtained through middleware upgrades, will both address the specific needs of the astronomical community and generate a positive feedback, since they will be usable by the whole EGEE multi-disciplinary user community.

These concepts and the impact expected from AGENA are in line with the topics addressed by the FP7 call.

1.1.2 Objectives of the project

The key objectives of AGENA are:

1. Providing Grid access to a large community of scientists which up to now has been involved only partially, if at all, in deploying its applications on the Grid.
   There are many problems in the astronomical domain which have up to now been tackled through the use of local computing resources, and could be easily expanded in terms of size and dimensionality by using the capacity computing provided by the Grid. An example could be a site providing on-demand theoretical models obtained exploring a multi-dimensional space of physical parameters; adding an additional parameter may hamper the possibility of making the computation locally, while the use of grid resources can solve the problem.
   Another example refers to the expansion of Virtual Observatory capabilities: there are growing requests from users to be able to perform tasks of additional computational complexity when accessing data stored in archives and databases. Performing cross-referencing on large data sets is computationally heavy, and could be solved by properly interoperating the Virtual Observatory and Grid infrastructures.

2. Dissemination, by liaising with a number of major projects in Europe related to astronomy, astrophysics and cosmology, and individual scientists, to support their capacity computing needs through the use of the Grid. The projects being currently carried out are becoming increasingly complex, and their need for computational resources is increasing as well. Quite a number of such projects could very well make use of Grid resources, e.g. for running scientific or engineering simulations: this has already proven to be true for some projects (Planck, MAGIC) supported by EGEE under the EGAAP programme.
   An appropriate dissemination and training plan for scientists and projects within and outside the AGENA consortium (with particular attention to institutions and projects in new EU member states and in candidate countries) is planned to be a key facility to allow sharing experiences and thus reinforcement of the impact, adoption and global relevance of the Grid.

3. Coordinating groups who are active in astronomical research and have already implemented the Grid paradigm for their computational needs. Several groups have already tested the Grid paradigm to satisfy their need for capacity computing: this has been done in several ways and within several environments, the most important being EGEE. Sharing of these experiences would be extremely valuable for new users, but also for staff having already direct knowledge of Grid internals.
   One of the many examples where sharing experiences would be beneficial refers to methods to allow efficient gridification of applications, e.g. by careful formatting on the size of the jobs to avoid small jobs (especially sequential or moderately parallel ones) that would generate a high pressure on the grid middleware for activation, data transfers, reporting, etc.
   Sharing of experiences would also be very important from the technical point of view, to be able to export on a wider scale some smart solutions adopted e.g. by a local or a campus grid.

4. Upgrading middleware through continuous feedback with Grid developers (particularly within EGEE), in order to allow new requirements coming from the astronomical community to be satisfied.
   The experience gathered up to now in the community has shown that astronomers use new and different paradigms in accessing Grid resources, and for the efficient use of the related applications on the Grid the current middleware evidences some limitations. An example can be considered the efficient access to large and complex databases, or the capability of performing processing of large datasets minimising the network load (i.e. “performing computation where the data are”).
   It is on the other hand obvious that upgrading the middleware in order to fulfil these requirements coming from the astronomical community, but general enough to be useful in other domains, will expand the capabilities of the Grid infrastructure itself enhancing its usage.

Key metrics measuring progress towards these key objectives are:

Coordination	meetings with key projects, standards development
Access	% reach of astronomy users utilising the AGENA service, application deployment, access to CPU and disk capacity, growth of users, citations of use of service in publications of science carried out using the service
Dissemination	reports and training events as summarised in Table 1.1c, where readership and attendance/ feedback will be tracked
Middleware	software releases as summarised in Table 1.1c

Specific metrics will be formalised during the early stages of the project planning process.

1. Providing Grid access to the community: this goal is linked to the whole set of operational WPs, both JRAs (which deal with gridification of “complex” applications) and the SAs (which support the Virtual Organisation and the gridification of “generic” applications). The activities of the WPs, including the eventual achievement of their objectives, will be documented and reported periodically through normal channels.
2. Liaising with projects and scientists: this goal is planned to be achieved through a proper dissemination and external training activity, to allow scientists and members of projects not belonging to the consortium to learn and use the mechanisms adopted by AGENA for the gridification of applications. Dedicated meetings are planned to be organised with staff of external projects to allow discussion of specific issues. The activities of the relevant WPs, including the production of dissemination and training material, will be documented and reported periodically through normal channels.
3. Coordinating astronomical groups already involved with the Grid: this goal is essentially planned to be reached within inter-WP groups where the previous experience and the one gathered along the development of the project will be discussed and a shared and agreed view of the project development will be reflected in the issuing of common development documents, and in the definition of a training activity internal to the consortium. The setup and activities of such coordination and training group(s) will be documented and reported periodically through normal channels.
4. Upgrading middleware: this goal is linked with the activities of WP7, a JRA which has some pre-defined activity to be carried out for the first cycle of project development, and in the second cycle will implement middleware upgrades to cope with new requirements, working in close cooperation with the relevant EGEE groups. The activities of the WP,

including the eventual achievement of their objectives, will be documented and reported periodically through normal channels.

1.1.3 Work concept

To achieve the objectives of the project, the work concept described in the following has been devised.

During the preliminary phases of the preparation of the proposal, some major research activities, requiring the integration on the Grid of complex (specific) applications, have been identified: these have been grouped in specific Joint Research Activities (JRAs). The identified JRAs deal with interoperability between Grid and Virtual Observatory standards (JRA2 = WP8), grid-enabling of astronomical data reduction (JRA3 = WP9), grid-enabling of astronomical numerical simulations (JRA4 = WP10).

Other applications, requiring less (or generic) support for their porting on the Grid, will be identified within the project coordination and strategy work-package, a Networking Activity (NA2 = WP2); each of these applications will be supported within a generalised Service Activity (SA2 = WP6) work-package.

A dedicated testing and benchmarking activity is included in each JRA (coordinated by WP2) and in WP6, to measure quantitatively the advantage of porting the code on the Grid and to identify and possibly remove inefficiencies and bottlenecks.

An additional JRA (JRA1 = WP7) will enhance and upgrade Grid middleware on the basis of requirements, part of which have been already identified at the time of proposal submission and part of which will be gathered subsequently within the other project work-packages.

A specific SA is foreseen (SA1 = WP5) to manage the Virtual Organisation and to support local sites in deploying their computational resources on the Grid. Training at the user level (NA4 = WP4) and the dissemination of the results (NA3 = WP3) are also included. The internal coordination of the project and the definition of its strategy (NA2 = WP2) and the general management of the project (NA1 = WP1) complete the list of foreseen work-packages.

The global list of work-packages is reported in Table 1.1a, the involvement of the various Partners is in Table 1.1b, and the list of deliverables is in Table 1.1c.

Table 1.1a – Overall Work-Package list

Work package No[1]	Work package title	Type of activity[2]	Lead participant No[3]	Lead participant short name	Person-months[4]	Start month[5]	End month Errore. Il segnalibro non è definito.
WP 1	Project Management	MGT	1	INAF	6	1	30
WP 2	Project Coordination and Strategy	COORD	1	INAF	31	1	30
WP 3	International Coordination and Dissemination	COORD	4	ESA	17	1	30
WP 4	Training	COORD	2	INFN	27	4	27
WP 5	Support of the Astronomical Virtual Organisation(s)	SVC	3	AIP	64	4	27
WP 6	Support for the Porting of Applications to the Computational Grid	SVC	2	INFN	45	4	27
WP 7	Development of Middleware Extensions	RTD	1	INAF	103	4	27
WP 8	Interoperability between the Grid and the Virtual Observatory	RTD	5	UCAM	76	4	27
WP 9	Grid-enabling of Astronomical Data Reduction	RTD	4	ESA	58	4	27
WP 10	Grid-enabling of Astronomical Numerical Simulations	RTD	6	CNRS	135	4	27
	TOTAL				562		

1 Work package number: WP 1 – WP n.

2 Please indicate <u>one</u> activity per work package:

RTD = Research and technological development; COORD = Co-ordination; SUPP = Support; MGT = Management of the consortium; SVC = Service activities.

3 Number of the participant leading the work in this work package.

4 The total number of person-months allocated to each work package.

5 Measured in months from the project start date (month 1).

Table 1.1b – Summary of staff effort

Participant number	**Participant short name**	**WP 1 NA1**	**WP 2 NA2**	**WP 3 NA3**	**WP 4 NA4**	**WP 5 SA1**	**WP 6 SA2**	**WP 7 JR1**	**WP 8 JR2**	**WP 9 JR3**	**WP 10 JR4**	**Total person months**
1	**INAF**	**0** **(4)**	**3** **(6)**	0 (3)	0 (6)		12 (0)	**15** **(3)**	6 (6)	12 (3)		48 (31)
2	**INFN**		0 (3)	0 (1)	**12** **(3)**		**18** **(3)**	18 (3)				48 (13)
3	**AIP** (*)		3	1	6	**18**		32		16	18	94
4	**ESA**		3 (1)	**6** **(3)**		4 (2)			6 (3)	**18** **(9)**		37 (18)
5	**UCAM**	0 (2)	3 (3)	0 (1)			0 (12)	15 (12)	**27** **(16)**			45 (46)
6	**CNRS**		0 (3)	0 (1)		24 (4)		0 (5)	0 (12)		**18** **(3)**	42 (64)
7	**CSIC**		0 (3)	0 (1)		0 (12)					48 (12)	48 (28)
-	**Total**	6	31	17	27	64	45	103	76	58	135	**562**

In the table, the number of person-months over the whole duration of the planned work is indicated, for each work package by each participant. The work-package leader for each WP is identified by showing the relevant person-month figures in bold.

The first line in each row indicates the number of person-months for which the EU contribution is requested; in the second line the numbers in parentheses indicate the number of person-months contributed to the project by the institution (matching staff). One partner (AIP) marked with an asterisk (*) has agreed to leave unspecified the level of staffing to be considered as contributed or to be supported by EU.

Table 1.1c – Overall List of Deliverables

Del. no. [6]	Deliverable name	WP no.	Nature [7]	Dissemi-nation level [8]	Delivery date [9] (proj. month)
D2.1	Project Presentation	WP2	O	PU	2
D2.2	Project Overview paper	WP2	O	PU	2
D3.1	Project Web site (internal)	WP3	O	CO	3
D1.1	Project Plan for Cycle 1	WP1	R	PP	3
D3.2	Project Web site (public)	WP3	O	PU	6
D2.3	Test & Benchmarking Policy	WP2	R	PU	6
D4.1	Training Plan	WP4	R	PU	6
D5.1	Virtual Organisation Implementation Plan	WP5	R	PU	6
D6.1	User Support Implementation Plan	WP6	R	PU	6
D6.2	Generic Applications Deployment Plan	WP6	R	PU	6
D7.1	Middleware Upgrade Implementation Plan	WP7	R	PU	6
D8.1	Virtual Observatory Interoperability Plan	WP8	R	PU	6
D9.1	Data Processing Applications Deployment Plan	WP9	R	PU	6
D10.1	Numerical Simulations Applications Deployment Plan	WP10	R	PU	6
D4.2	First Training Workshop	WP4	O	PU	9
D7.2	First prototype release of upgraded middleware components	WP7	O	PU	12
D8.2	Beta release of interface software facade linking VObs and Grid	WP8	O	PU	12

6 Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>. For example, deliverable 4.2 would be the second deliverable from work package 4.

7 Please indicate the nature of the deliverable using one of the following codes:
R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

8 Please indicate the dissemination level using one of the following codes:
PU = Public
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).

9 Measured in months from the project start date (month 1).

D3.4	Major update of Project Web sites	WP3	O	PU/CO	15
D4.3	Training Report and Revised Plan	WP4	R	PU	15
D5.2	Virtual Organisation Report and Revised Implementation Plan	WP5	R	PU	15
D6.3	User Support and Generic Applications Deployment Report and Revised Plan	WP6	R	PU	15
D7.3	Middleware Upgrade Report and Revised Implementation Plan	WP7	R	PU	15
D8.3	Virtual Observatory Report and Revised Interoperability Plan	WP8	R	PU	15
D9.2	Data Processing Applications Deployment Report and Revised Plan	WP9	R	PU	15
D10.2	Numerical Simulations Applications Deployment Report and Revised Plan	WP10	R	PU	15
D1.2	Intermediate Contractual Report and Project Plan for Cycle 2	WP1	R	PP	16
D2.4	First version of Software Repository	WP2	O	PU	17
D4.4	Second Training Workshop	WP4	O	PU	18
D7.4	Final validated release of upgraded middleware components	WP7	O	PU	24
D3.5	Final update of Project Web site	WP3	O	PU	27
D4.5	Training Report	WP4	R	PU	27
D5.3	Virtual Organisation Report	WP5	R	PU	27
D6.4	Generic Applications Deploy-ment Report	WP6	R	PU	27
D7.5	Middleware Upgrade Report	WP7	R	PU	27
D8.4	Virtual Observatory Interoperability Report	WP8	R	PU	27
D9.3	Data Processing Applications Deployment Report	WP9	R	PU	27
D10.3	Numerical Simuulations Applications Deployment Report	WP10	R	PU	27
D2.5	Second version of Software Repository	WP2	O	PU	29
D1.3	Final Contractual report	WP1	R	PP	30

As the first report to the EU, after 3 months, the Project Plan for Phase 1 (D1.1) will be delivered. This document sets the basis for the project development. At the same time the internal Web site (D3.1) will have been created for circulation of information within the project. A presentation of the project (D2.1) and a project overview paper (D2.2) will have been created (within month 2) by the project leaders, aimed mainly at dissemination.

At month 6, a whole set of documents shall be ready and will be delivered: Benchmarking Policy (D2.3), Training Plan (D4.1), Virtual Organisation Implementation Plan (D5.1), User Support Implementation Plan (D6.1), Generic Applications Deployment Plan (D6.2), Middleware Update Implementation Plan (D7.1), Virtual Observatory Interoperability Plan (D8.1), Data Processing Applications Deployment Plan (D9.1), Numerical Simulations Applications Deployment Plan (D10.1).

The first training workshop (D4.2) on EGEE middleware and the porting of applications will occur at month 9.

On month 12, the first release of software and middleware components will occur: the prototype release of upgraded middleware (D7.2) and the Beta release of interface software facade linking VObs and Grid (D8.2).

During month 16, the Intermediate Contractual Report and Project Plan for Phase 2 (D1.2) will be delivered, which collates and harmonises a whole set of reports due on month 15: Training Report and Revised Plan (D4.2), Virtual Organisation Report and Revised Implementation Plan (D5.2), User Support and Generic Applications Deployment Report and Revised Plan (D6.3), Middleware Update Report and Revised Implementation Plan (D7.2), Virtual Observatory Report and Revised Interoperability Plan (D8.2), Data Processing Applications Deployment Report and Revised Plan (D9.2), Numerical Simulations Applications Deployment Report and Revised Plan (D10.2).

The first version of the software repository (D2.4) will be available on month 17, and the code stored therein will constitute integral part of the Second Training Workshop (D4.4). The second and final version of the software repository (D2.5) will be available to the scientific community at large on month 29.

During month 27 the following reports will be produced: Training Report (D4.3), Virtual Organisation Report (D5.3), Generic Applications Deployment Report (D6.4), Middleware Update Report (D7.3), Virtual Observatory Interoperability Report (D8.3), Data Processing Applications Deployment Report (D9.3), Numerical Simulations Applications Deployment Report (D10.3). Such reports will be collated and complemented by final project remarks, into the Final Contractual Report (D1.3), which will be delivered during month 30.

Other documentation, such as requirement documents, design documents, test plans and reports and benchmarks will be considered as internal, although a summary of their content may be included, as relevant, in the reports to be delivered. The same applies to other types of deliverables, e.g. software, prototypes, updates of web sites.

1.2 Provision of integrated services and co-ordination of high quality research

1.2.1 State of the art

Astronomy has historically been mainly an observational science, thus the core of the community has been concentrating, since about ten years, on access to distributed data, using standards defined within the international Virtual Observatory; this activity is represented in Europe by the Euro-VO project. This approach does not completely fulfil the needs of the community, as computational astrophysics has become an important part of astronomical research. Some projects have started to use the Grid infrastructure for topics requiring capacity computing; up to now, however, this has been done in a somewhat uncoordinated way.

Some experiences in the field at the European level are mentioned in the following.

In the 2004-2005 framework, two astrophysics-related projects were approved by the EGEE Generic Applications Advisory Panel (EGAAP) to run their numerical applications on the EGEE infrastructure. MAGIC is an international collaboration operating at La Palma (Canary Islands) since fall 2003 an imaging atmospheric Cerenkov telescope which produces up to 200 GB of data per night; a second telescope is in construction. The analysis of data is based on Montecarlo methods simulating the hadronic background to explore the energy range 10 GeV – 100 GeV. Planck is an ESA mission to image the anisotropies of the Cosmic Microwave Background, to be launched in 2008. In order to evaluate the impact of systematic effects on the scientific results of the mission before real data are obtained, and to properly design, implement and test the algorithms needed to solve the critical data reduction problems, the mission is simulated completely several times under different cosmological hypotheses and instrumental nominal and non-nominal conditions. Both projects have set up Virtual Organisations and are running their simulations on the EGEE infrastructure.

The LOFAR project (an innovative telescope forcing a breakthrough in the measurement of radio-frequencies below 250 MHz, by using an array of simple omni-directional antennas spread over several European countries) has developed a number of applications using Grid facilities.

Within the Euro-VO framework, a work-package of the EU/FP6-funded VO-DCA project is aiming at achieving coordination between the Virtual Observatory and computational Grids, by organising the activities necessary to allow VObs users to exploit (through the data centres involved in the project) the processing capabilities offered by computational Grid projects, at the campus, national or European level, with special reference to EGEE. Among the tasks to be performed, the following can be mentioned: performing preparatory studies on how to interface VObs computing tasks with the different computational Grids, through contacts with user communities and technical groups, fostering access by data centres to own national Grids, verifying that requirements from the VObs community are taken in the appropriate consideration by the individual computational Grid projects, maintaining contacts with computational Grid projects and the GGF, verifying the feasibility of layering VObs standards on top of the Grid middleware.

Some experiences in the coordination at the national level of Grid activities for the astronomical domain have been gathered in some of the countries involved in this project. They are reported in the following.

In Italy, INAF and INFN participated from 2001 to 2006 in *Grid.it*, funded under the National Research Programme, a Grid Computing project having a strong interdisciplinary character, and aimed at defining, implementing and applying innovative solutions for network computing enabling platforms, oriented towards scalable Virtual Organisations. The project included the development of demonstrators selected within application fields of high scientific value used as test-beds for high performance Grid platforms: Earth Observation, Geophysics, Astronomy, Biology and Genomics, Computational chemistry. As an evolution of Grid.it, IGI (the Association for the Italian Grid Infrastructure) has been established to provide long term sustainability for the Italian Grid. IGI acts as national coordinator for the different pieces of the Italian e-Infrastructure present in EGEE II. Both INAF and INFN are IGI partners.
INAF participated in two grid-centred national projects. Within the “Applications” activity of *Grid.it* (coordinated by INFN), a dedicated work-package has tackled three specific issues related to astronomical research:

- Grid-enabled access to astronomical databases (with development of some prototype middleware);
- distributed processing of astronomical images using standard Grid middleware;
- monitoring of astronomical instruments using Grid techniques (with development of prototype middleware).

A separate project (*DRACO*) was funded by the Ministry of Education and Research to allow the porting of astronomical applications on the Grid.
The results of the *Grid.it* and *DRACO* projects were presented at a workshop in Nov. 2005 (http://wwwas.oats.inaf.it/grid/index.php?option=com_content&task=view&id=94&Itemid=121).
INAF participation in both *Grid.it* and *DRACO* ended in December 2005. Since then, the *DRACO-2* project was funded by INAF as a service activity to coordinate distributed computing across the organisation through the usage of Grid techniques.
Within EGEE, INAF took the initiative of proposing to EGAAP the porting to the Grid of numerical simulations of the Planck mission (the proposal was approved in November 2004). INAF scientists lead the Planck Virtual Organisation (VOrg), which was successful in porting the simulation codes to the EGEE infrastructure.
INAF participates in the EGEE-II NA4 work-package (as unfunded partners) with the task of coordinating the integration of astronomical applications.
Furthermore, in the VO-DCA project, funded under EU/FP6, INAF leads the “Coordination with the computational grid” work-package, having the purpose of achieving coordination between the Virtual Observatory partners and the computational grid communities.
INAF-IRA is a partner in the SKADS-FP6 project. The availability of a large collecting area (30.000 mq) of the "Northern Cross Array" of Medicina offer a interesting test-bed where concepts and technologies for SKA can be tested. The Medicina Radiotelescopes site has a dark fiber connection with the Italian Tier-1 (INFN/CNAF) grid node. The radiotelescopes of Medicina, Noto and the new Sardinia Radio Telescope (SRT) are involved in the Express-FP6 project for the e-VLBI, and the parabola of Medicina is one of the five antennas in Europe that can made e-VLBI observations at a sustained speed of 512 Mbit/sec. The INAF astronomical community is starting in the porting of radioastronomical applications on the Grid architecture.
The SRT will host one of the clusters of CPUs interconnected by photonic networks to create a geographic grid node of about 1000 CPUs (CyberSar, funded by the ministry of Research

through the PON initiative). There are other regional consortia, with participation of astrophysicists, aimed at building and managing computational grids for scientific and industrial applications: Grid@Trieste, the TriGRID Virtual Laboratory project funded by the Sicilian Regional Government using funds from EU (Objective 1 area), and PI2S2 funded through PON.

The AstroGrid-D project is the German initiative to build a nation-wide grid infrastructure for astronomy and a collaborative working environment. Computing hardware of astronomical institutes as well as data archives, instruments and experiments were integrated for that purpose. The project is sponsored by the German ministry of research and education and managed by the Astrophysical Institute Potsdam (AIP). Most major astronomical and astrophysical research institutes in Germany are members or associates, however, the greater goal of the project is to promote and implement the usage of grid middleware among the whole German astrophysical community.

After the first 18 months of project time, the hardware base of the German AstroGrid is still growing. It currently includes about two dozens compute resources permanently available, including over 750 cluster nodes and storage servers offering almost 100 TB of storage space. Additionally, the job submission process for a network of five robotic telescopes is currently being developed. AstroGrid-D is running on the most current version of the Globus Toolkit (GT4) as its software platform an advanced grid middleware solution that allows for high flexibility in resource integration while offering a wide range of services; user identification and secure communication is based on the X.509 certificate standard.

AstroGrid-D has also successfully produced several important software elements. The "Stellaris" Information Service is a general purpose information service addressing requirements of metadata management in Grids, targeted at a diverse set of scientific use cases of the astronomical community while also servicing general Grid requirements. For the management of grid users and virtual organisation, AstroGrid-D uses VOMRS, a service aimed at enhancing the capabilities of the currently widely used VOMS; the AstroGrid-D extension of the VOMRS allows each grid resource to query one or several known VOMRS databases and provides a range of options to limit access according to virtual organisation membership or user details. Other architecture elements of AstroGrid-D include: Job management and monitoring (AstroGrid-D uses an extended version of the Job Submission Description Language JSDL), Database access and data stream management (through the OGSA-DAI package), standardised Web-based User Interfaces using the GridSphere web portal, the Grid Application Toolkit (GAT), e.g. for an adapter prototype to submit jobs to Sun Grid Engine managed clusters.

An important task of the AstroGrid-D is the integration of astrophysical instruments, especially robotic telescopes, aiming for a uniform interface to telescope resources with a monitoring and scheduling mechanism, enabled by the GT4 grid platform to provide the necessary security layer, information service and storage and data-transmission infrastructure. AstroGrid-D will also work on grid interfaces for other instrument types, the most prominent example being the low frequency array project LOFAR.

AstroGrid-D has also implemented several scientific software packages for the use with grid middleware. One goal within AGENA is to share the experiences and offer the available software for scientific use with the EGEE grid. Examples for numerical codes integrated by AstroGrid-D are Cactus, a solver for the Einstein equations and Dynamo, a software model of turbulent, magneto-hydrodynamic plasma.

Also AstroGrid-D has implemented the NBODY6++ code, a powerful star cluster and galaxy modelling package. This example application for the use of the special purpose GRAPE hardware was first being employed by AstroGrid-D's ZAH together with the CNRS. Recently

advanced hardware concepts such as using reconfigurable chips (FPGA) have been introduced, for which software is currently being developed. The new type of flexible hardware makes it possible to broaden the scientific range of applications for the codes, including “Smoothed Particle Hydrodynamics” (SPH). The work has met great interest with international collaborations that will take part in the software and hardware integration using results obtained from this and similar projects.
An example use case for astrophysical data reduction is given by the ProC scientific workflow engine, which has been supplied with a grid interface based on the Grid Application Toolkit (GAT). The engine is currently mainly used for investigation of the cosmic microwave background (CMB), originally developed for ESA’s Planck Surveyor satellite mission. In conjunction with its integrated Data Management Component (DMC), the ProC permits to trace the provenance of data. This feature guarantees the reproducibility of results, which is an important asset in data intensive projects such as Planck or LOFAR. ProC is undergoing further development to allow a general use in data reduction and astrophysical workflows.

The ESA Space Astronomy Centre (ESAC) of the European Space Agency (ESA) holds the Science Operations Centres of most ESA astronomy missions. In that context, the scientific archives of most ESA astronomy missions (ISO, XMM-Newton, Integral for the time being, Herschel, Planck and Gaia in the future) are also located at ESAC. Initially, internal computational Grid facilities have been setup to offer improved computing facilities to the ESAC scientists for their day to day scientific data reduction activities. By joining the EGEE Grid, ESAC scientists can now benefit wider and more powerful Grid resources and ESAC can offer data processing capabilities for both internal and external scientific users.
Furthermore, one of the tasks of the ESAC Science Operations Centres is to perform routinely massive data processing to turn the raw data received from the satellites into scientific data to be archived and then distributed to the scientific community. This bulk processing paradigm is well adapted to the computational Grid paradigm as it means routinely processing or re-processing data with a well established data reduction package, run over many datasets, hence that can easily be done in parallel. For Herschel (to be launched in 2008), ESAC will be in charge of the routine data processing and this will be done on the Grid, using both internal and EGEE resources. That will be a precursor to other future missions like GAIA where hundreds (or even thousands) of processing will be required and therefore the Grid will impose itself as the only solution for such data processing challenge.
Overall, ESAC goal is to migrate from a data centre into a data processing centre where naturally data access and data computing are coupled through the Virtual Observatory and the Grid paradigms.

AstroGrid (represented in this project by UCAM) has been funded in the UK since Oct 2001 to develop a pervasive Virtual Observatory infrastructure to better facilitate astronomer discovery, access and manipulation of global astronomical data and application resources. To this end it has played a major role in the development of the international VObs, being a founder member of the International Virtual Observatory Alliance, main partner in the EU FP5 funded European Astrophysical Virtual Observatory project, and now lead partner in the EU FP6 funded Euro-VO Technology Centre (VO-Tech). AstroGrid is a flagship project of the UK eScience programme, the success of this leading to the development of similar systems in other countries - such as the German D-Grid activities.
Within the UK, AstroGrid is deploying its VObs infrastructure across the UK as it moves into an operational phase from 2008. It has more than 600 registered UK astronomy users, and many more anonymous users of its system. It provides access to all UK held data sets, and through standard interfaces (many of which it has actively defined) to major global resources,

thus those offered by the Canadian Astronomical Data Centre, ESAC, SDSS, NRAO, etc. The main components of its system include a meta-data rich registry, a data set access component, allowing interface to a range of RDBMS, a work-flow system based on the OMII-Taverna product, a authentication and authorisation model utilising X509 certificates, a virtual storage system (VOSpace, the VObs data grid), system login, an applications execution framework, a protocol for client side application message parsing. Through the interface to 'grid' systems, jobs are now run on UK resources such as those at the EPCC in Edinburgh, university condor flocks (such as the Cambridge University Camgrid system), and through the astronomy AstroGrid network in the UK. Additionally AstroGrid have demonstrated interoperability between their VObs infrastructure and grid resources in the UK. For instance it is possible to transparently access the Montage service at Caltech via the AstroGrid workbench and generate large multi GB image mosaics on demand where the data exists in Caltech, the application is run at the SDSC in San Diego and the results returned to a user VOSpace in Cambridge.
Major new data resources are now being published exclusively through AstroGrid data components. The IPHAS consortium (http://www.iphas.org) first data release will shortly (1 June 2007) be made available - representing photometry of some 200 million unique objects in the Galactic plane and being one of the top few catalogues in astronomy in terms of size. The AstroGrid system is supporting science from cosmology through to Solar Physics A recent description of the AstroGrid system is described in Walton et al (2006, A&G, 47, 22), whilst the key role of the VObs in maximising the science return from future large astronomical facilities such as the ELT is described in Walton et al (2006, Proc IAU Symp 232, 398)

In France Grid activities have been fostered by an "Incentive Concerted Action" (ACI) launched in 2001 and devoted to mega-databases and distributed computing. Several projects were supported.
Most CNRS people (notably within the HORIZON collaboration) have ported applications to Grid'5000 (https://www.grid5000.fr/mediawiki/index.php/Grid5000:Home) which is one initiative of the French ACI Grid incentive which provides a large part of Grid'5000 funding on behalf of the French Ministry of Research & Education. Grid'5000 is a research effort developing a large scale nation wide infrastructure for Grid research. Grid'5000 project aims at building a highly reconfigurable, controllable and monitorable experimental Grid platform gathering 9 sites geographically distributed in France featuring a total of 5000 CPUs. The main purpose of this platform is to serve as an experimental test-bed for IT research in Grid Computing. This project involves 17 laboratories, nation wide, in the objective of providing the community of Grid researchers a test-bed allowing experiments in all the software layers between the network protocols up to the applications.
Another project was the development of the light CIGRI middleware in Grenoble. CIGRI (http://cigri.gforge.inria.fr/) enables several users to submit jobs on a grid regrouping several computing clusters. CIGRI is presently dedicated to multi-parametric studies. This simple goal permits a native operation on heterogeneous environments, provides the flexibility to exploit idle processors and to operate concurrently with conventional batch mode on each cluster. This project is linked with the development of the OAR light batch scheduler (http://oar.imag.fr/) which is currently deployed on large clusters in Grid'5000. CNRS people in Grenoble have been involved in the specifications and testing of CIGRI and OAR, and have demonstrated its ability to tackle with large campaigns of millions of jobs.

CSIC leads the Interactive European Grid project, funded by EU/FP6 with 1 May 2006 as the starting date and a duration of 24 months. The objective of the project is the deployment of an

advanced Grid empowered infrastructure in the European Research Area specifically oriented to support the execution of interactive demanding applications. The consortium involves 13 leading institutions in 7 countries, with significant computing capacity and expertise in grid technology.
While guaranteeing interoperability with existing large e-Infrastructures like EGEE by providing basic common middleware services, the initiative exploits the expertise generated by the EU CrossGrid project to provide researchers an interactive and simultaneous access to large distributed facilities through a friendly interface with powerful visualization.
The Interactive European Grid, while interoperable with EGEE, focuses on interactive use for a whole set of research areas where demanding interactive applications that can benefit from being grid-enhanced have been identified.
Within CSIC, the Instituto de Fisica de Cantabria (IFCA) participates in the project the porting to the EGEE infrastructure of numerical simulations of the Planck mission, approved by EGAAP in November 2004, and participate in the Planck Virtual Organisation .

1.2.2 Improvements over the state of the art

Quite a number of improvements over the state of the art can be expected as an output from the AGENA project. They are described in the following.

This project intends to coordinate, in five different countries and within one multi-site international organisation, a number of national and local projects which are already using the Grid for the solution of their computational problems. This coordination activity, done with the participation of EGEE developers, will allow sharing of experiences, cross-fertilisation, exchange of tools and ideas, spreading of new paradigms and practices. As a result, a strong(er) user community will be created, capable of taking full advantage of the benefits of the Grid.

As part of their participation in the project, partners will commit resources, attaching some of their computing facilities to the Grid. By such means the infrastructure will be enhanced. Consequently, on one side the size of the Grid will grow; on the other, sustainable Grid support to projects will be granted.

Focus will be set within AGENA on the implementation into EGEE of resources and products available within the national projects. All partners will thus profit from the synergy effects that arise from the mutual exchange in know how and person-power. At the same time services will be extended and improved for a wider, international use.

The experience gathered up to now has shown that astronomers use new and different paradigms in accessing Grid resources. Some of these mechanisms (especially in the field of database access) have been identified and require the adaptation and/or the upgrade of the EGEE middleware; it is expected that within the project new requirements coming from the astronomical community will emerge and will generate new EGEE middleware upgrades. As mentioned above, a number of solutions have been found and implemented in the middleware in use within local or national Grids managed by AGENA partners; integrating on EGEE such solutions already in use, as being proposed in this project, would be beneficial. All of these upgrades will enhance and expand the capabilities of the Grid infrastructure itself, improving the capabilities of users in all scientific domains.

A key point for the astronomical community is to keep and reinforce the possibility of accessing observational data and numerical simulations through the Virtual Observatory, while enhancing its computational capabilities. An integrated approach is therefore expected as a result of AGENA, so as to allow a complete interoperability between the Grid infrastructure and the Virtual Observatory, possibly obtained through the layering of the relevant Virtual Observatory services on top of Grid middleware.

The project has foreseen an intensive dissemination and training plan for individual scientists within and outside the AGENA consortium (with particular attention to new EU member states and candidate countries). Through the appropriate exploitation of this initiative, the knowledge of the grid e-Infrastructure by the astronomical community will greatly increase, and consequently its usage will be greatly expanded.

AGENA is also planning to interact with large infrastructure projects for astronomy (e.g. SKA and the ELT among others), to verify the usability of Grid techniques for the solution of their computational and data handling/processing challenges. Coordination with these projects will be pursued to allow cross-fertilisation (discussion of requirements, dissemination of results, spread of best practice, etc.).

The introduction of Europe-wide Virtual Organisation(s) will further improve the sharing of computational resources and simplify collaboration of potential research partners. It will reduce the obstacle of non-compliant middleware stacks from different grids and further integrate existing European hardware resources.

1.3 Networking Activities and associated work plan

1.3.1 Project overall organisation

The project will last 30 months and it will be organised into several phases.

There will be Kick-off phase of 3 months. The first meeting of the Project Board constitutes the project kick-off (the Board is defined in section 2.1 of this proposal, and is composed of the contact persons for every organisation). The Board nominates the members of the Executive Technical Team (in principle the leaders of all WPs numbered from 3 to 10 listed in Table 1.1a), and of the Science Advisory Team. Such bodies also hold their kick-off meetings. At the end of the Kick-off phase, the project detailed work program, and the Project Web site for internal circulation of information, will be available.

Two one-year Cycles, Cycle 1 and Cycle 2 are foreseen. The project activities are assessed at the end of the first yearly cycle and adjusted as required for the second cycle.

Mid-term and final reports are produced by WPs from 3 to 10 one month before the end of each Cycle. The reports are assessed by the Executive Technical Team which prepares, respectively, a mid-term and final activity report. The Executive Technical Team proposes a plan for future activities to the Board at the end of Cycle 1. At the end of Cycle 1, the Board produces the detailed work program for Cycle 2.

A Final Phase of 3 months, during which the final project reports are produced. Only WP1 and WP2 will be active during the Final Phase.

In the following, the timing of the project overall organisation is presented as a Gantt chart, and a graphical representation of the basic components and their interdependencies is given in the form of a Pert diagram.

	WBS	Task Name	Duration	Start
1	1	AGENA Kick-off Phase	3 mons	Tue 01/01/08
7	2	AGENA Cycle 1 - NA	12 mons	Tue 01/04/08
16	3	AGENA Cycle 2 - NA	12 mons	Wed 01/04/09
23	4	AGENA Cycle 1 - SA	12 mons	Tue 01/04/08
30	5	AGENA Cycle 2 - SA	12 mons	Wed 01/04/09
34	6	AGENA Cycle 1 - JRA	12 mons	Tue 01/04/08
46	7	AGENA Cycle 2 - JRA	12 mons	Wed 01/04/09
53	8	AGENA Final Phase	3 mons	Thu 01/04/10

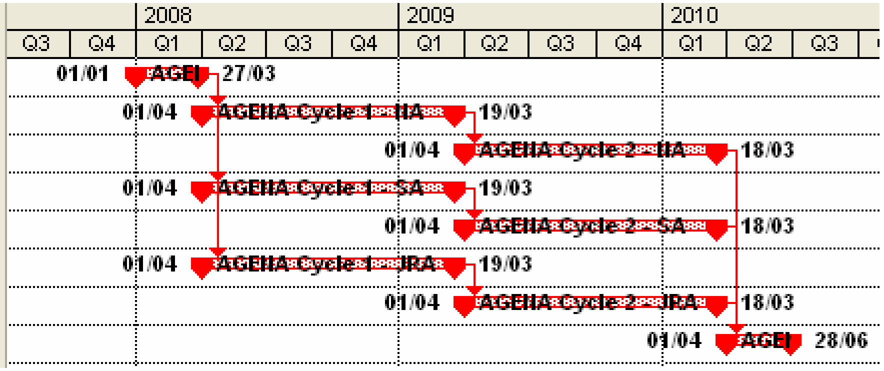

Figure 1.3.1 – Project overall organisation: Gantt chart.

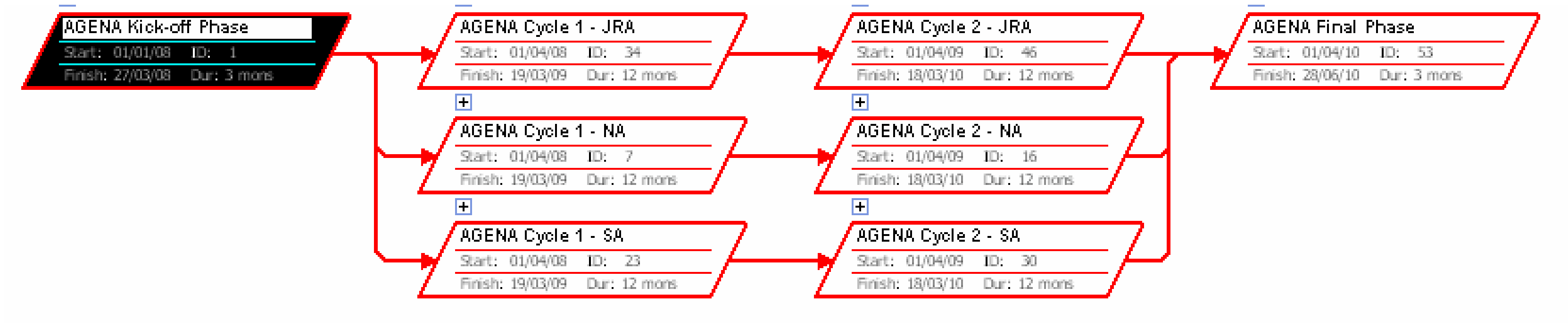

Figure 1.3.2 – Project overall organisation: Pert diagram

1.3.2 *Project overall milestones*

This is the global list of milestones for the whole AGENA project, which are shared by all the Work Packages. They will thus be referred to in the description of Service Activities (section 1.4.1) and Joint Research Activities (section 1.5.1).

Table 1.3a – List of milestones

Milestone number	Milestone name	Work package(s) involved?	Expected date [10]	Means of verification[11]
M1	Project kick-off	all	Month 1	Agenda and Minutes of the Board kick-off meeting
M2	First ETT meeting	all	Month 2	Agenda, Minutes and viewgraphs of the meeting (to be subsequently posted on internal Web site)
M3	Project Plan approval	all	Month 3	D1.1 – Project Plan for Cycle 1
M4	First SAT meeting	WP2	Month 4	Agenda and minutes of the SAC meeting
M5	Approval of individual WP plans	all	Month 6	D4.1, D5.1, D6.1, D7.1, D8.1, D9.1, D10.1
M6	Approval of Test & Benchmarking Policy	WP2, WP4	Month 6	D2.3 – Test & Benchmarking Policy
M7	First call for generic applications	WP2, WP6	Month 6	Text of call available on public Web site
M8	Approval of the generic applications	WP2, WP6	Month 8	Prioritised list of approved applications available on public Web site
M9	First training workshop	WP4	Month 9	D4.2 Agenda and training material of the workshop on the public Web site
M10	First middleware and software release	WP2, WP7, WP8	Month 12	Prototype code on Project Software Repository
M11	Approval of revised individual WP plans	all	Month 15	D4.3, D5.2, D6.3, D7.3, D8.3, D9.2, D10.2

[10] Measured in months from the project start date (month 1).
[11] Show how both the participants and the Commission can check that the milestone has been attained. Refer to indicators if appropriate.

M12	Second call for generic applications	WP2, WP6	Month 15	Text of call available on public Web site
M13	Mid-term meeting (Board, ETT and SAT)	all	Month 16	Agenda and Minutes of the Board mid-term meeting on Web site
M14	Intermediate Contractual Report	WP1	Month 16	D1.2
M15	Revised Project Plan approval	all	Month 16	D1.2 – Project Plan for Cycle 2
M16	Approval of the generic applications	WP2, WP6	Month 17	Prioritised list of approved applications available on public Web site
M17	Second training workshop	WP4	Month 18	D4.4 Agenda and training material of the workshop on the public Web site
M18	Validated release of upgraded middleware	WP2, WP7	Month 24	D7.4 Validated code on Project Software Repository
M19	Approval of WP reports	all	Month 27	D4.5, D5.3, D6.4, D7.5, D8.4, D9.3, D10.3
M20	Final middleware and software release	WP2, WP7, WP8, WP9, WP10	Month 29	Final code on Project Software Repository
M14	Intermediate Contractual Report	WP1	Month 30	D1.3

1.3.3 Risk assessment

The risks related to the AGENA project that have been identified are stored in a Risk Register, assessed and classified using the fairly standard following scheme:

- likelihood of occurrence (1 = very unlikely to 4= highly likely)
- likely impact (1 = minimal impact, 4 = disastrous)

The product of (likelihood of occurrence * likely impact) provides the risk factor (ranging from 1 (minimal risk) to 16 (extremely high risk).

Risks with a highest risk factor are the ones on which attention should be mostly focused. For each identified risk a mitigation action is provided. The Risk Register is maintained, in the sense that it is periodically verified, to add new risks or to update the risk factors: if the mitigation actions are performed successfully, risks may be retired from the Register.

In the following sections, risks are divided by type of activity (NA, SA, JRA).

1.3.4 NA: General strategy

To achieve the high-level objectives of the project, several areas of work related to Networking Activities have been identified, each corresponding to a Work Package, one for the general management of the project, and three co-ordinating activities for the pursuit of cooperation and strategic objectives within the project, for cooperation with the relevant external communities, and for dissemination of knowledge, including the spreading of good practices.

Each Work Package is under responsibility of one partner. Sub-Work Packages may be identified at a later stage, if/when required, for activities which will produce specific internal or public deliverables. Each Sub-Work Package will also be under the responsibility of one partner.

The four networking Work Packages are defined as follows:

- Management activities
    - WP1: Project Management (led by INAF)
- Coordination activities
    - WP2: Project Coordination and Strategy (led by INAF). This WP2 includes the activities of project coordination bodies defined in Section 2 of this proposal (Project Board, Executive Technical Team, Science Advisory Team).
    - WP3: International Coordination and Dissemination (led by ESA).
    - WP4: Training (led by INFN)

During the Kick-off phase, only WP1, WP2 and WP3 will be active. At the end of the Kick-off phase, WP2 produces the project detailed work program for Cycle 1, and WP3 provides the Project Web site for internal circulation of information.

During Cycle 1 and Cycle 2 all WPs are active. WPs from 3 to 10 (with their sub-WPs) produce respectively mid-term and final reports one month before the end of each Cycle. As part of the WP2 activities, the reports are assessed by the Executive Technical Team which prepares respectively a mid-term and final activity report. The Executive Technical Team proposes a plan for future activities to the Board at the end of Cycle 1. At the end of Cycle 1, the Board produces the detailed work program for Cycle 2.

During the Final Phase, only WP1 and WP2 will be active; the final project reports are produced by WP2.

The preparation of the reports is a task of WP2, while their actual delivery to the EU together with the budget reports is a task of WP1.

In the following, the tables the referring to the Networking Activities are reported: Work-Package list, Summary of staff effort, List of deliverables. Gantt and Pert diagrams are provided, together with the List of risks and mitigation actions.

Table 1.3b – Work package list

Work package No[12]	Work package title	Type of activity[13]	Lead participant No[14]	Lead participant short name	Person-months[15]	Start month[16]	End monthErrore. Il segnalibro non è definito.
WP1	Project Management	MGT	1	INAF	6	1	30
WP2	Project Coordination and Strategy	COORD	1	INAF	31	1	30
WP3	International Coordination and Dissemination	COORD	3	ESA	17	1	27
WP4	Training	COORD	2	INFN	27	4	27
	TOTAL				81		

Table 1.3c – Summary of staff effort

Parti-cipant number	Parti-cipant short name	WP 1 NA1	WP 2 NA2	WP 3 NA3	WP 4 NA4	Total person months
1	INAF	**4**	**9**	3	6	22
2	INFN		3	1	**15**	19
3	AIP		3	1	6	10
4	ESA		4	**9**		13
5	UCAM	2	6	1		9
6	CNRS		3	1		4
7	CSIC		3	1		4
-	**Total**	6	31	17	27	81

12 Work package number: WP 1 – WP n.

13 Please indicate one activity per work package:

RTD = Research and technological development; COORD = Co-ordination; SUPP = Support; MGT = Management of the consortium; SVC = Service activities.

14 Number of the participant leading the work in this work package.

15 The total number of person-months allocated to each work package.

16 Measured in months from the project start date (month 1).

Table 1.3d – List of Deliverables

Del. no. [17]	**Deliverable name**	**WP no.**	**Nature**[18]	**Dissemi-nation level** [19]	**Delivery date**[20] **(proj. month)**
D2.1	Project Presentation	WP2	O	PU	2
D2.2	Project Overview paper	WP2	O	PU	2
D3.1	Project Web site (internal)	WP3	O	CO	3
D1.1	Project Plan for Cycle 1	WP1	R	PP	3
D3.2	Project Web site (public)	WP3	O	PU	6
D3.3	Project promotional material	WP3	O	PU	6
D2.3	Test & Benchmarking Policy	WP2	R	PU	6
D4.1	Training Events Plan	WP4	R	PU	6
D4.2	First Training Workshop	WP4	O	PU	9
D3.4	Major update of Project Web sites	WP3	O	PU/CO	15
D4.3	Training Report and Revised Plan	WP4	R	PU	15
D1.2	Intermediate Contractual Report and Project Plan for Cycle 2	WP1	R	PP	16
D2.4	First version of Software Repository	WP2	O	PU	17
D4.4	Second Training Workshop	WP4	O	PU	18
D3.5	Final update of Project Web site	WP3	O	PU	27
D4.5	Training Report	WP4	R	PU	27
D2.5	Second version of Software Repository	WP2	O	PU	29
D1.3	Final Contractual report	WP1	R	PP	30

17 Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>. For example, deliverable 4.2 would be the second deliverable from work package 4.

18 Please indicate the nature of the deliverable using one of the following codes:
R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

19 Please indicate the dissemination level using one of the following codes:
PU = Public
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).

20 Measured in months from the project start date (month 1).

Table 1.3e – List of risks and mitigation actions

Risk	Consequences	Mitigation Actions
Risk NA-R1: Failure to reach agreement on the policies and strategies for the project Likelihood of occurrence=2 Impact=3 **Risk Factor = 6**	Discussions within the Board and the Executive Technical Team will not lead to a shared vision of the project's policies and strategies, hampering the possibility of a unified view of the project.	AGENA partners share the overall vision of the project, e.g. reaching the possibility of expanding the Grid infrastructure capacities for the benefit of the community. Different technical solutions may be pursued, with a close eye on allowing interoperability between them. This solution has a higher cost in terms of person-power.
Risk NA-R2: Failure to achieve cross-activity coordination Likelihood of occurrence=2 Impact=3 **Risk Factor = 6**	Failure to achieve consensus within the governing teams of the project, or limited collaboration among teams may hampering the possibility of achieving a set of results sharing the same technical solutions. This would lead to possible misuse or duplication of efforts.	Special care will be taken to ensure that the NA2 and SA2 (WP2 and WP6) activities work in good agreement, since SA2 depends on NA2 decisions: this will be enforced by periodic one-on-one meetings via teleconference. As for other work-packages, special meetings via teleconference for the ETT and the Board will be set whenever a problem between/among work-packages arises.
Risk NA-R3: Different evaluation within the project of the priorities for middleware upgrades Likelihood of occurrence=2 Impact=2 **Risk Factor = 4**	A set of contradicting requirements and/or indications would be sent to JRA1 (WP7) for the implementation of the middleware upgrades, with the possibility of using JRA1 resources inefficiently.	Coordination within the ETT is expected, otherwise the Board will decide. In any case, close contact with the EGEE development team (part of which is included in this proposal) will help sorting out priorities. If consensus cannot be reached in AGENA's Board, the middleware upgrade having the highest positive impact on the outside community will have the highest priority.
Risk NA-R4: Wrong evaluation within the project of the technical feasibility of middleware upgrades Likelihood of occurrence=2 Impact=2 **Risk Factor = 4**	Priorities in selecting issues to be solved by middleware upgrades may be driven by an incomplete/wrong understanding of the complexity of the upgrade to be implemented, possibly leading to an inefficient use of JRA1 resources.	Close contact with the EGEE development team (part of which is included in this proposal) will help understanding the real complexity of the identified middleware upgrades. If possible, some upgrades may be implemented by EGEE.
Risk NA-R5: Lack of convergence between the scope of training and the real needs of the communities	If the scope of the training activities is too vague or too general, not in line with the real needs of the users and developers communities, there will be few attendances to the training events and their impact will be limited.	AGENA partners are involved in Grid projects since the early days. They have scientists who are doing science requiring massive computing and who wish to enhance the performance of their codes. Some partners have already a long tradition in the organisation of Grid training. In the

Likelihood of occurrence=1 Impact=3 **Risk Factor = 3**		ETT or Board, it shall be easy to identify the needs and requirements for such events so there is little risk that the scope of these workshops is not adequate.

The identified risks for the Network Activities of the AGENA project have risk factors up to 6, with mitigation actions in all cases that would limit the impact of such risks. The overall level of risk of the AGENA Network Activities is low.

In the following pages, the timing of the organisation for Networking Activities is presented as Gantt charts, and graphical representation of the NA components and their interdependencies is given in the form of Pert diagrams. They are subdivided by project phases.

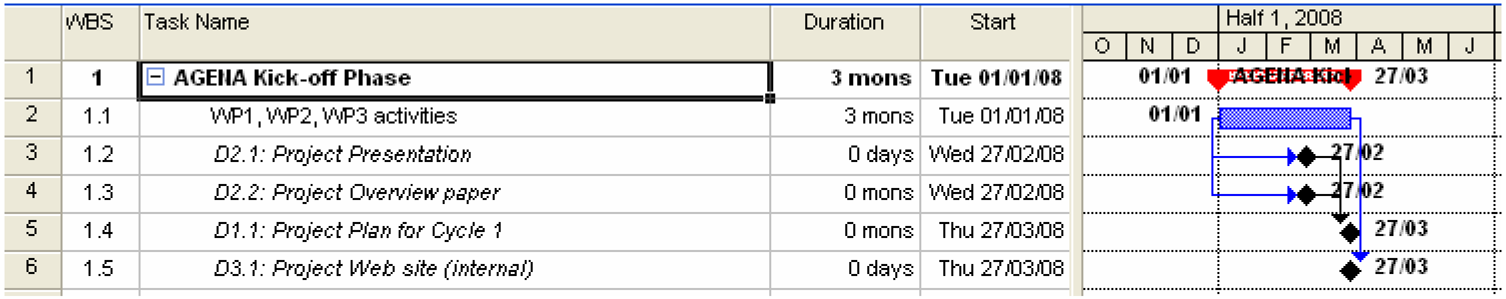

Figure 1.3.3 – NA organisation: Gantt chart for Kick-off Phase.

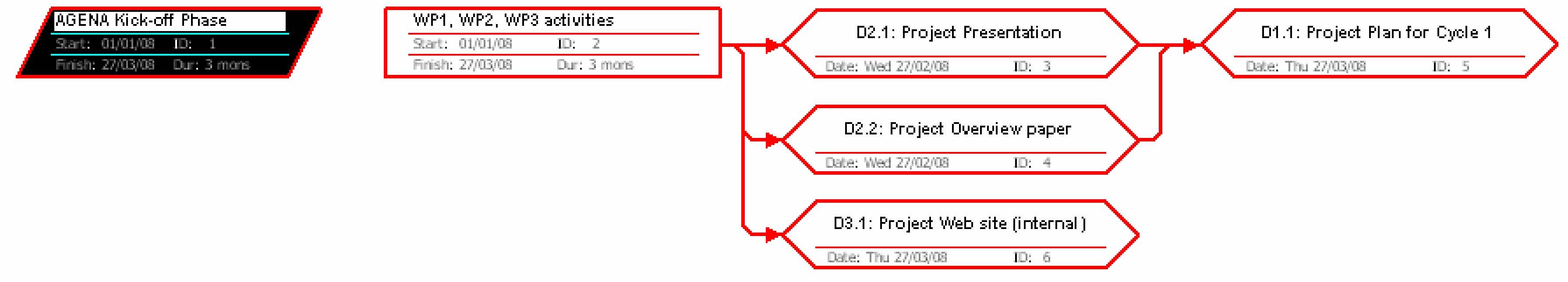

Figure 1.3.4 – NA organisation: Pert diagram for Kick-off Phase.

	WBS	Task Name	Duration	Start
7	**2**	**AGENA Cycle 1 - NA**	**12 mons**	**Tue 01/04/08**
8	2.1	WP1, WP2, WP3, WP4 Networking Activities	12 mons	Tue 01/04/08
9	2.2	*D2.3: Test & Benchmarking Policy*	0 mons	Fri 27/06/08
10	2.3	*D3.2: Project Web site (public)*	0 mons	Fri 27/06/08
11	2.4	*D3.3: Project Promotional material available*	0 mons	Fri 27/06/08
12	2.5	*D3.4: Major update of Project public Web Site*	0 mons	Thu 19/03/09
13	2.6	*D4.1: Training Plan*	0 mons	Fri 27/06/08
14	2.7	*D4.2: First Training Workshop*	0 mons	Wed 24/09/08
15	2.8	*D4.3: Training Report and Revised Plan*	0 days	Thu 19/03/09
16	**3**	**AGENA Cycle 2 - NA**	**12 mons**	**Wed 01/04/09**
17	3.1	WP1, WP2, WP3, WP4 Networking Activities	12 mons	Wed 01/04/09
18	3.2	*D1.2 : Intermediate Contractual Report and Project Plan*	0 mons	Wed 29/04/09
19	3.3	*D2.4: First version of Software Repository*	0 mons	Thu 28/05/09
20	3.4	*D3.5: Final update of Project public Web Site*	0 mons	Thu 18/03/10
21	3.5	*D4.4: Second Training Workshop*	0 days	Fri 26/06/09
22	3.6	*D4.5: Training Report*	0 days	Thu 18/03/10

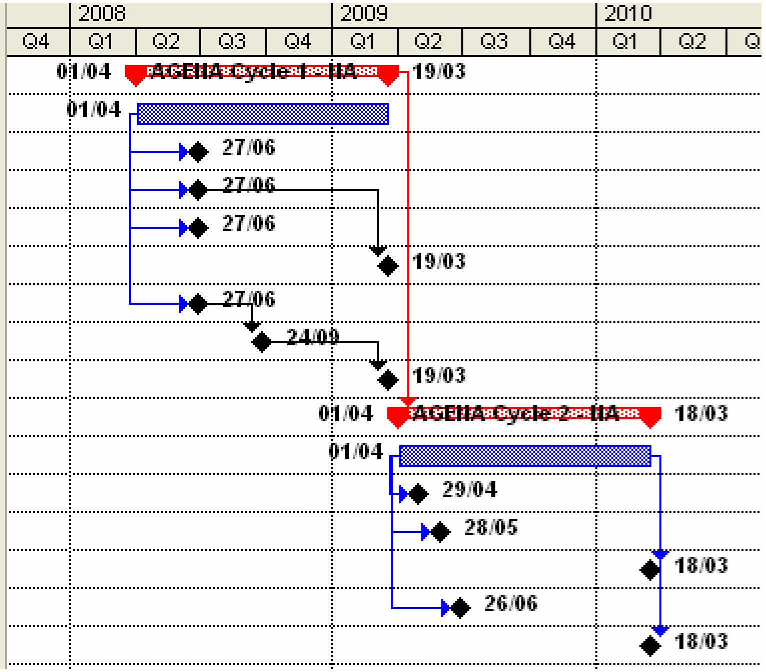

Figure 1.3.5 – NA organisation: Gantt chart for Cycles 1 and 2.

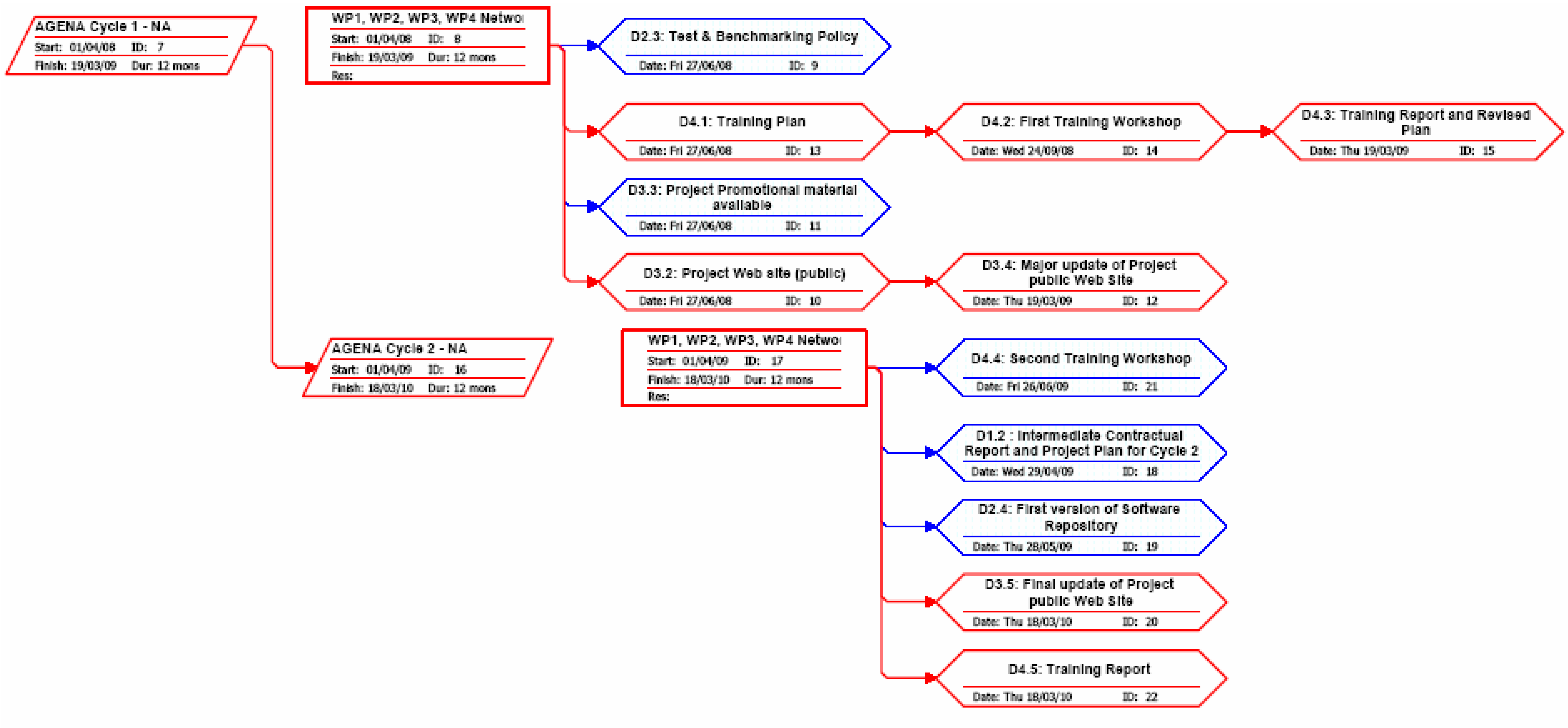

Figure 1.3.6 – NA organisation: Pert diagram for Cycles 1 and 2.

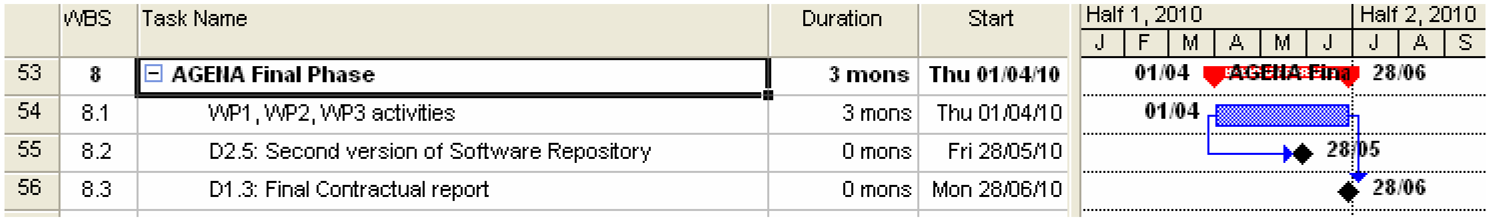

Figure 1.3.7 – NA organisation: Gantt chart for Final Phase.

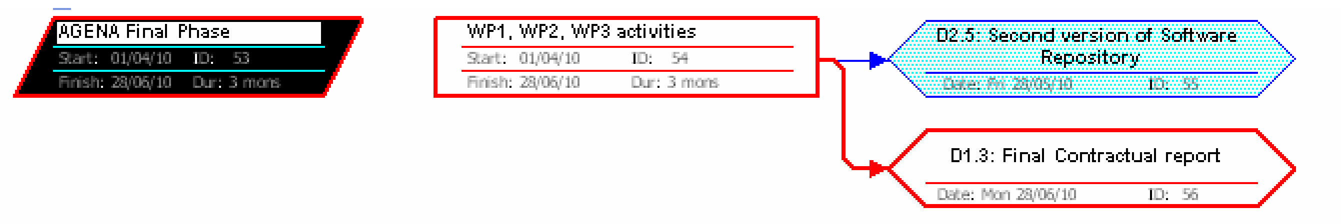

Figure 1.3.8 – NA organisation: Pert diagram for Final Phase.

1.3.5 WP1 – NA1: Project Management

Work package description

Work package number	WP1	**Start date or starting event:**		Kick-off		
Work package title	Project Management					
Activity Type[21]	MGT					
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant	**4**				2		

Objectives

- overall management of the project and of the Consortium;
- administration: coordination of financial and administrative matters;
- official representation of the project and interface with the EU.

Description of work (possibly broken down into tasks) and role of partners

- T1.1 – Overall legal, contractual, financial and administrative management activities, including
    - establishment and maintenance of the Consortium Agreement
    - obtaining audit certificates as needed
    - keeping track of the meetings organised and maintain the documentation produced by the project
- T1.2 – Interface with the EU
    - production of the contractual reports
    - participation in meetings organised by EU
    - disseminate within the project information provided by EU

Deliverables (brief description) and month of delivery

- D1.1 (Month 3) – Project Plan for Cycle 1 (includes the report to EU on activities carried out during the Kick-off period)

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[21] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

- D1.2 (Month 16) – Intermediate Contractual Report and Project Plan for Cycle 2
- D1.3 (Month 30) – Final contractual report to EU

The aim of WP1 is to provide the overall legal, contractual, financial and administrative management activities. This includes the maintenance of the Consortium agreement and obtaining audit certificates whenever appropriate. WP1 will produce the contractual reports, keep track of the milestones and of the reports produced by the project, and check that these take place in due time.

WP1 will furthermore act as the official representation of the project and the single interface with the EU, seeking information and support from the other WPs as appropriate. The WP1 will ensure participation in the meetings organised by EU and will in charge of disseminating within AGENA all of the information provided by EU. It will furthermore produce the contractual reports to be delivered to the EU.

Financial support is sought for:
Travel costs for Project Coordinator, Administrator: € 10000
Audit costs, as needed: € 10000
External contract for part-time Project Controlling: € 30000

All other personnel in WP1 will be contributed by INAF.

1.3.6 WP2 – NA2: Project Coordination and Strategy

Work package description

Work package number	WP2	**Start date or starting event:**		Kick-off		
Work package title	Project Coordination and Strategy						
Activity Type[22]	COORD						
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant	**9**	3	3	4	6	3	3

Objectives

- define policies and strategies for the project;
- cross-activity coordination;
- setup Product Assurance and Risk Management activities;
- identifying applications requiring generic/standard support for their porting on the Grid;
- gathering and evaluation of user requirements for middleware updates;
- formal and technical coordination with EGEE;
- prepare planning for support, test and benchmarking activities;
- assess project progress and results.

Description of work (possibly broken down into tasks) and role of partners

- T2.1 – Project Board: definition of strategies, approval of proposed generic applications for their porting on the Grid, approval of proposed middleware updates, approval of plans for support, test and benchmarking activities, formal coordination with EGEE, global assessment of project progress and results.
- T2.2 – Executive Technical Team: cross-activity technical coordination, identification and evaluation of proposed generic applications for their porting on the Grid, identification and evaluation of proposed middleware updates, preparation of plan for test and benchmarking activities, technical coordination with EGEE, technical assessment of project progress and results.
- T2.3 – Science Advisory Committee: scientific guidance; definition of drivers to motivate the porting of applications to the Grid; scientific assessment of project progress and results.

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[22] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

Deliverables (brief description) and month of delivery

- D2.1 – Project presentation (Month 2)
- D2.2 – Project overview paper (Month 2)
- D2.3 – Testing and Benchmarking Policy (Month 6)
- D2.4 – Test First version of Software Repository (Month 17)
- D2.5 – Test First version of Software Repository (Month 29)

The main aim of WP2 is to achieve coordination across activities: this can be reflected in the definition of the detailed project programme, to be achieved through two Cycles. This is a task of the Board, which will homogenize within a single plan the strategies and specific objectives of the individual partners, which are expected to be somewhat different depending in particular on the guidance of their funding agencies. The Board decides the detailed work program for each project Cycle, on the basis of reports from the Executive Technical Team and the Science Advisory Team.

WP2 will also, through the Board and the Executive Technical Team, coordinate the gathering of user requirements for the porting on the Grid of applications, both the "complex" ones targeted by the Joint Research Activities and the "generic" ones. For the latter, WP2 is in charge of identifying and selecting applications requiring generic/standard support for their porting on the Grid. Being in charge of these aspects of the project, WP2 is where the identification of possible synergies and collaborations, especially around common instrumental projects, will occur. This will be a task of the Board.

The Board, as part of WP2, will also assess project progress and results, monitoring regularly the activity of the WPs, and producing whenever necessary the formal reports to the EU.

Within WP2, Product Assurance activities will be organised, supported and enforced. A relevant number of person-months will be dedicated to this task. Furthermore, Risk Management will be dealt with: a Risk Register will be established and maintained by the Executive Technical Team throughout the duration of the project.

WP2 will also prepare detailed planning for testing and benchmarking activities; this is essentially a task of the Executive Technical Team. These are generic activities valid for all development and support WPs, thus a unified approach is required. The testing and benchmarking plan shall contain the principles and generic procedures to be followed.

The Executive Technical Team, as part of WP2, coordinates all AGENA technical activities; additionally, it coordinates the distribution of the software and middleware produced within the project.

The activity of the project Science Advisory Team is also part of WP2. The SAT will in particular highlight scientific drivers to motivate the porting of applications to the Grids. These drivers will focus on both the short term immediate scientific benefits, as well as identifying larger long term benefits.

WP2 will be in charge of the formal and technical coordination with EGEE: the former is a task of the Board, the latter will be carried out by the ETT.

Board, ETT and SAT will assess progress and results of the project and will provide inputs, related to their own fields of competence, to WP1 for the editing of the formal reports to the EU.

Most activities of Board, ETT and SAT will occur by e-mail and/or teleconference, but a number of face-to-face meetings is foreseen. The Board is planned to meet for Kick-Off, after 6 months, at the end of cycle 1 and at the end of the project; the ETT is planned to meet during the Kick-Off phase, after 6 months during Cycle 1, at the end of cycle 1, during Cycle 2 and at the end of the project; the SAT is planned to meet after 4-5 months, at the end of cycle 1 and at the end of the project.

Financial support is sought for a teleconferencing facility, and for travel costs to four Board meetings, six ETT meetings and three SAT meetings, on the basis of the following considerations:

- Teleconferencing facility: € 8000
- One European travel = 800 Euro, one international travel = 1600 Euro
- 4 Board meetings (8 members): € 25600
- 6 ETT meetings (10 members): € 48000
- 3 SAT meetings (7 members): € 16800

Total: € 98400

All personnel in WP2 will be contributed by the partners as shown in the WP description table.

1.3.7 WP3 – NA3: International Coordination and Dissemination

Work package description

Work package number	WP3	**Start date or starting event:**			Kick-off		
Work package title	International Coordination and Dissemination						
Activity Type[23]	COORD						
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant	3	1	1	**9**	1	1	1

Objectives

- public outreach of the AGENA project;
- coordinating project activities with other similar initiatives;
- external web presence with content coming from the other WPs to bring to the external community the AGENA activities, findings, lessons learned, tutorials, on-line help, etc…
- internal web site (probably through a wiki server) for the project internal communication among partners;
- relations with the media, promotional material, presentation of the project (activities, demos, results) during conferences and workshops;
- when relevant, international cooperation with other projects.

Description of work (possibly broken down into tasks) and role of partners

- T3.1 – Setting up of the project internal web site for smooth communication between partners will be the 1st activity and should be finalized at the end of the project kick-off phase.
- T3.2 – Setting up the project external web presence should come soon after in order to advertise the objectives and the activities of the project. After every year, the external web site should be updated significantly to reflect the results of the project activities, with inputs from all the WPs.
- T3.3 – Through the duration of the project, results and/or demos should be presented at the relevant conferences or workshops and international cooperation with other projects will also be sought.

[23] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

Deliverables (brief description) and month of delivery

- D3.1 – AGENA Internal web site ready (Month 3)
- D3.2 – AGENA external web site ready (Month 6)
- D3.3 – AGENA promotional material available (Month 6)
- D3.4 – Major update of AGENA Web sites (Month 15)
- D3.5 – Final update of AGENA Web site (Month 27)

The objective of NA3 (International Coordination and Dissemination) is to perform the public outreach of the AGENA project as well as coordinating its activities with other similar initiatives. That will include an external web presence with content coming from the other WPs to bring to the external community the AGENA activities, findings, lessons learned, tutorials, on-line help, etc… There will also be an internal web site (probably through a wiki server) for the project internal communication between partners. Public presence will also be assured through relations with the media, promotional material, presentation of the project (activities, demos, results) during conferences and workshops. When relevant, international cooperation with other projects will also be sought.

Internal communication within the AGENA partners and within the participants of all work package is essential for the success of the project, specially as partners are geographically distributed. An internal collaborative web site (eg wiki) will be setup so all partners and WP participants can directly add their inputs and activities in the internal web site so there is good information flow within the project. Mailing lists will also be defined and setup to allow faster and direct interaction between the partners.

Additionally, AGENA external presence will also be met via an external web site. The purpose of this web site is to ensure public outreach of the project towards the astronomical scientific community. The project web site shall include:

- Description of the AGENA project, its goals and objectives
- Project organization, project participants and their respective roles within the project
- Project plan and associated milestones
- Information about project public events
- Information of the AGENA Virtual Organization for people to join in
- Results of presentations, demos presented at external conferences and workshops
- Examples of Grid usage for scientific tasks, on-line tutorials and demos
- Request for feedback from the community

As part of the AGENA dissemination activities, project results should be presented to international conferences and workshops both in the astronomical context and in other more Grid related context.

Relations with the media and production of promotional material will also take place within this WP, including relations with end users, promotion of resources sharing across national initiative and encouraging international cooperation with other projects.

1.3.8 WP4 – NA4: Training

Work package description

Work package number	WP4	**Start date or starting event:**		Kick-off + 3M		
Work package title	Training					
Activity Type[24]	COORD					
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant	6	**15**	6				

Objectives

- production of training and course material;
- support e-learning;
- organisation of on-site courses.

Description of work (possibly broken down into tasks) and role of partners

- T4.1: EGEE tutorials – This task aims to organise training courses for application developers and site managers about EGEE middleware and the deployment of the gLite middleware on the partners' computing resources. Training material will be produced and made publicly available after each course.
- T4.2: Astrophysics software tutorials – This task aims to provide documentation, tutorials, support and training courses for users and application developers specifically on the porting of astrophysical applications to grid, and on the tools and services available on the grid.

Deliverables (brief description) and month of delivery

- D4.1 – Training Plan (Month 6)
- D4.2 – First Training Workshop (Month 9)
- D4.3 – Report on training activity and revised plan (Month 15)
- D4.4 – Second Training Workshop (Month 18)
- D4.5 – Final report on training activity (Month 27)

[24] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

This activity aims to organise, in cooperation whenever relevant with the EGEE project corresponding activity, tutorials and training events in which the current architecture of the EGEE middleware and its planned evolution will be presented to the Astronomy, Astrophysics and Cosmology communities, in order to expand the use of the EGEE Grid e-infrastructure and foster their adoption in these fields.

The leading partner of this Work Package, INFN, has a longstanding experience in running training events and tutorials about Grid technologies, and is managing since several years a training infrastructure (t-infrastructure) called GILDA (Grid INFN Laboratory for Dissemination Activities, https://gilda.ct.infn.it/) spread over three continents and now a reference point for dissemination and training activities.

A t-infrastructure, i.e. an e-infrastructure for knowledge dissemination, is a complete Grid environment with a set of special features and specific solutions for knowledge dissemination available to teachers and students with devoted solutions.

This infrastructure provides in fact:

- its own basic services;
- its own Computing Elements (CE), Worker Nodes (WN), Storage Elements (SE) and User Interfaces (UI);
- customised facilities, thought to made easy tutorials implementation as a Certification Authority with ad hoc policies;
- a powerful interface able to hide the complexity of the argument to beginner users and independent from operating systems and devices used;
- specialised solutions for tutorials, as a collection of hands-on exercises books and simple instructions to guide the attendees in using the infrastructure to learn;
- specialised solutions for topics strictly related to knowledge dissemination.

The idea behind GILDA was to implement a parallel, independent test-bed entirely devoted to tutorials, with the same middleware and services available in the production test-bed. By this way while the production test-bed was free to evolve and to work without any problem bound to tutorial plans, with the GILDA test-bed we were able to provide several tutorials in parallel in different parts of the world.

The updating plans of the two test-beds are slightly different because while in the production test-bed we follow the users' need, in the GILDA test-bed all is thought in function of the tutorials planned.

GILDA allows also trying the integration of new technologies and study as they interact with the platforms that already exist. In this way it is also possible to realize tutorials on new technologies before they are ready on the production Grid. Moreover it is possible to test new applications and their integration into the Grid environment using a temporary VOrg, without any interference with the production Grid infrastructure.

The training activity about EGEE will be carried out by INFN with INAF support for astronomy-specific issues. Two objectives will be sought:

- to train the users and application developers on how to run and/or port their applications on the EGEE e-infrastructure
- to train the resource managers of the project partners to deploy the Grid middleware on their resources and then join the EGEE e-infrastructure

In the tutorials, additional complementary training about specific Astrophysics tools will be provided by Astrogrid-D with INAF support. The information will include, but will not be limited to: the use of the Stellaris information services, the use of web interfaces for the Grid, and newly adopted software for data reduction and simulation. User training and support are planned to be provided via forum, e-mail, and phone; grid-related assistance to astrophysicists during research activities will be provided.

Specifically, support will be provided for existing and new users of the “Stellaris” information server in the form of documentation, direct contact, workshops and common environments for issue tracking and collaboration, and for Grid developers for the GridSphere portlet to the Cactus application for theoretical astrophysics. Tutorials including demonstration workflows will be provided for the ProC system, to be gridified within WP9.

A minimum of two training events will be organised during the lifetime of the project. Furthermore, recorded tutorials and lessons will be available on-line using the pod-cast technology.

1.4 Trans-national Access and/or Service Activities, and associated work plan[25]

1.4.1 SA: General strategy

To allow the project to achieve its objectives related to the creation of one or more coordinated Virtual Organisation(s) and to the ability of individual scientists of groups belonging to the astronomical community to port their applications on the Grid, two areas of work related to Service Activities have been identified: each has been made correspond to a Work Package, one dealing with the management and support of the Virtual Organisation(s), one for the support to the user community in the porting of "generic" applications.

Each Work Package is under responsibility of one partner. Sub-Work Packages may be identified at a later stage, if/when required, for activities which will produce specific internal or public deliverables. Each Sub-Work Package will also be under the responsibility of one partner.

The two service Work Packages are defined as follows:

- Service activities
    - WP5: Support of the Astronomical Virtual Organisation(s) (led by AIP)
    - WP6: Support for the Porting of Applications to the Grid (led by INFN)

WP5 and WP6 will start immediately after the Kick-off phase of the project, in which the project detailed work program for Cycle 1 is defined..

SA WPs (and their sub-WPs) produce respectively mid-term and final reports one month before the end of each one-year Cycle. Their reports are assessed by the Executive Technical Team which prepares respectively a mid-term and final activity report. The plan is revised at the end of Cycle 1and an updated plan is produced for Cycle 2, subject to the agreement of the Executive Technical Team and approval of the Board. A final report is produced at the end of the project.

In the following, the tables the referring to the Service Activities are reported: Work-Package list, Summary of staff effort, List of deliverables, Gantt and Pert diagrams are provided, together with the List of risks and mitigation actions. The SA milestones are indicated in the Table1.3a, section 1.3.2, which contains all of the project milestones.

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[25] Regarding Trans-national Access, an updated version of this Guide for Applicants will be made available at the time of the next call that will involve these activities and will address this more specifically.

Table 1.4a – Work package list

Work package No[26]	Work package title	Type of activity[27]	Lead participant No[28]	Lead participant short name	Person-months[29]	Start month[30]	End month Errore. Il segnalibro non è definito.
WP5	Support of the Astronomical Virtual Organisation(s)	SVC	3	AIP	64	4	27
WP6	Support for the Porting of Applications to the Grid	SVC	2	INFN	45	4	27
	TOTAL				109		

Table 1.4b – Summary of staff effort

Parti-cipant number	Parti-cipant short name	WP 5 SA1	WP 6 SA2	Total person months
1	INAF		12	12
2	INFN		**21**	21
3	AIP	**18**		18
4	ESA	6		6
5	UCAM		12	12
6	CNRS	28		28
7	CSIC	12		12
-	Total	64	45	109

26 Work package number: WP 1 – WP n.

27 Please indicate one activity per work package:

RTD = Research and technological development; COORD = Co-ordination; SUPP = Support; MGT = Management of the consortium; SVC = Service activities.

28 Number of the participant leading the work in this work package.

29 The total number of person-months allocated to each work package.

30 Measured in months from the project start date (month 1).

Table 1.4c – List of Deliverables

Del. no. [31]	**Deliverable name**	**WP no.**	**Nature**[32]	**Dissemi-nation level** [33]	**Delivery date**[34] **(proj. month)**
D5.1	Virtual Organisation Implementation Plan	WP5	R	PU	6
D6.1	User Support Implementation Plan	WP6	R	PU	6
D6.2	Generic Applications Deployment Plan	WP6	R	PU	6
D5.2	Virtual Organisation Report and Revised Implementation Plan	WP5	R	PU	15
D6.3	User Support and Generic Applications Deployment Report and Revised Plan	WP6	R	PU	15
D5.3	Virtual Organisation Report	WP5	R	PU	27
D6.4	Generic Applications Deploy-ment Report	WP6	R	PU	27

31 Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>. For example, deliverable 4.2 would be the second deliverable from work package 4.

32 Please indicate the nature of the deliverable using one of the following codes:
R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

33 Please indicate the dissemination level using one of the following codes:
PU = Public
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).

34 Measured in months from the project start date (month 1).

Table 1.4d – List of risks and mitigation actions

Risk	Consequences	Mitigation Actions
Risk SA-R1: **Not enough human resources to perform the Service Activities** Likelihood of occurrence=2 Impact=3 **Risk Factor = 6**	Some of the tasks within these Service Activities could require more person-power than currently planned. For example, the effort needed to port scientists' applications on the Grid could result more complex, or take longer than expected due to specific code idiosyncrasies. This would lead to a slow-down of the porting of other applications. The output of these AGENA services activities would be limited by the funded and contributed person-power.	Service Activities will need to be prioritized by decision of the Board and technical advice from the ETT, to make sure resources are directed first to what is more important. If necessary, partners involved in Service Activities could seek through their own funding to increase their contributed person-power to be able to cope with the extra work-load.
Risk SA-R2: **Lack of convergence between the scope of the Service Activities and the real needs of the communities** Likelihood of occurrence=2 Impact=3 **Risk Factor = 6**	Groups in charge of Service Activities may opt to choose technical solutions which are in contrast with the needs or experiences of the user communities they are expected to support (e.g. in the management of the Virtual Organisation, or in the porting of user code on the Grid).	The plan for the deployment of the Service Activities will need to be clearly defined and agreed by the Board under technical advice from the ETT, where a match between user needs and services provided will be made.
Risk SA-R3: **Support for the porting of user applications does not meet user expectations** Likelihood of occurrence=3 Impact=2 **Risk Factor = 6**	Because of lack of person-power, or unexpected complexity of applications, or time pressure, and the consequent poor interaction between Service and developer, the gridification of selected user applications may not be implemented, or implemented only partially.	In this case, mitigation can occur only a-priori, through a two-phase process: first, at selection time, a careful analysis of the application technical characteristics; then, the continuous interaction with the code developer to provide the useful information to allow the developer to successfully performing the porting
Risk SA-R4: **Lack of interest of the Scientific Community for porting their applications on the Grid** Likelihood of occurrence=1 Impact=4 **Risk Factor = 4**	If the Scientific Community is not interested in the Grid and is not willing to port their application, the AGENA project will loose a big fraction of its interest.	There is already a growing community of scientists using the Grid or interested in doing so. Through the Science Advisory Team and WP3 (outreach and dissemination), the AGENA project will make sure to stay close to the Scientific Community. Information on the potential benefits of the Grid will be spread. Tools to simplify code integration will be integrated and will be distributed to ease gridification to meet the community needs.

The identified risks for the Service Activities of the AGENA project have risk factors up to 9, with mitigation actions in all cases that would limit the impact of such risks. The overall level of risk of the AGENA Service Activities is low.

In the following pages, the timing of the organisation for Service Activities is presented as a Gantt chart, and graphical representation of the SA components and their interdependencies is given in the form of a Pert diagram.

	WBS	Task Name	Duration	Start
23	**4**	**AGENA Cycle 1 - SA**	**12 mons**	**Tue 01/04/08**
24	4.1	WP5, WP6 Service Activities	12 mons	Tue 01/04/08
25	4.2	*D5.1 : Virtual Organisation Implementation Plan*	0 mons	Fri 27/06/08
26	4.3	*D5.2: Virtual Organisation Report and Revised Implemei*	0 days	Thu 19/03/09
27	4.4	*D6.1 : User Support Implementation Plan*	0 mons	Fri 27/06/08
28	4.5	*D6.2: Generic Applications Deployment Plan*	0 mons	Fri 27/06/08
29	4.6	*D6.3 : User Support and Generic Applications Deployme*	0 days	Thu 19/03/09
30	**5**	**AGENA Cycle 2 - SA**	**12 mons**	**Wed 01/04/09**
31	5.1	WP5, WP6 Service Activities	12 mons	Wed 01/04/09
32	5.2	*D5.3: Virtual Organisation Report*	0 mons	Thu 18/03/10
33	5.3	*D6.4 : Generic Applications Deploy-ment Report*	0 mons	Thu 18/03/10

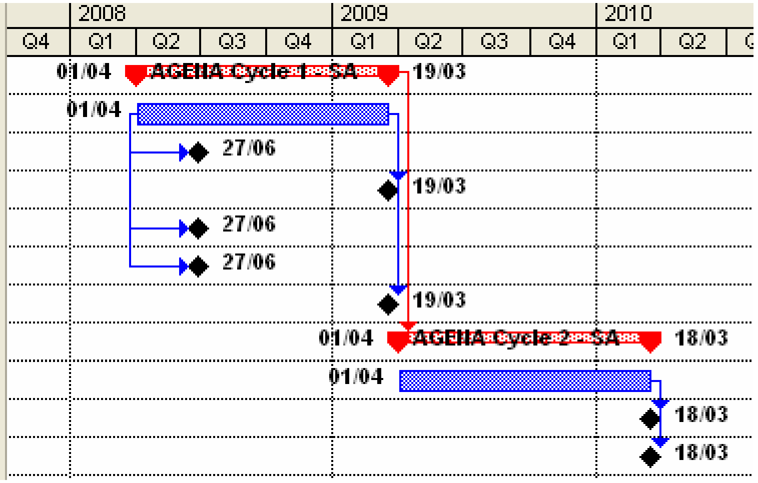

Figure 1.4.1 – SA organisation: Gantt chart.

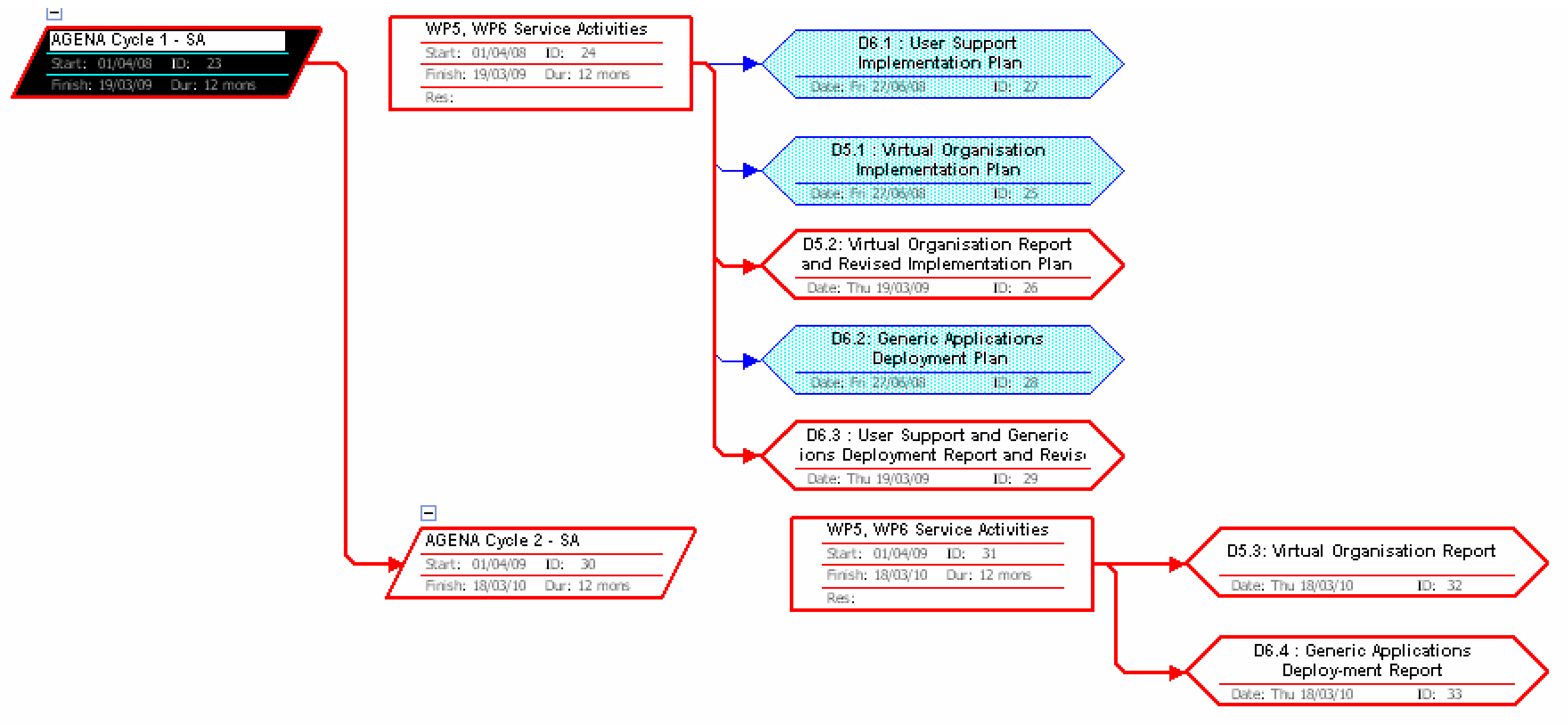

Figure 1.4.2 – SA organisation: Pert diagram.

1.4.2 WP5 – SA1: Support of the Astronomical Virtual Organisation(s)

Work package description

Work package number	WP5	**Start date or starting event:**			Kick-off + 3M	
Work package title	Support of the Astronomical Virtual Organisation(s)						
Activity Type[35]	SVC						
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant			**18**	6		28	12

Objectives

- operate and manage the Virtual Organisation(s) created within the project;
- monitoring and control;
- support to local sites for middleware and resource deployment.

Description of work (possibly broken down into tasks) and role of partners

- T5.1 – Establish an Authentication Procedure
- T5.2 – Establish a VOrg Management System
- T5.3 – Establish a Monitoring Procedure
- T5.4 – Support of local/national infrastructure

Deliverables (brief description) and month of delivery

- D5.1 – Virtual Organisation Implementation Plan (Month 6)
- D5.2 – Virtual Organisation Report and Revised Implementation Plan (Month 15)
- D5.3 – Virtual Organisation Report (Month 27)

Building a EU wide grid for Astronomy requires efficient user and resource management. The key concept to achieve this goal is called “Virtual Organisations” (VOrg’s). A VOrg bundles

[35] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

users and resources for a given project and allows the users to control and share the grid enabled resources.

To realise this concept, an extensive VOrg-Management system is needed that covers the different forms of grid middleware used. The project aims to develop such a system and also form an European Virtual Organisation in Astronomy to allow an EU-wide sharing of astronomical resources.

The project comprises organisations of different types: national grid projects and a supranational organisation such as ESA, where grid-enabled resources are (or will be) allocated to process data generated by space projects.
The national grid projects are built on different middleware. Also the Virtual Observatory environment requires particular interfaces for its workflow and tools to operate with grid-enabled resources.

Task 1- Establish an Authentication Procedure: Authentication and authorization of access to resources through grid middleware is based on X509 certificates. In accordance with the policies of the EUGridPMA we will use certificates only from Certification Authorities (CA) accredited with the EUGridPMA. Registration Authorities at astronomical institutes must be established in each country with the respective CA to enable easy access to certificates for users and resource providers. The supranational organisations could do the same through their national stations. Building up the certification chain using EUGridPMA ensures compatibility with EGEE and the whole grid world.

Task 2 – Establish a VOrg Management System: Authorisation to use grid resources depends on membership to a Virtual Organisation. Registering and mapping the given certificates to a respective Virtual Organisations is a separate task. By extending services and tools developed in EGEE, namely VOMS, and additionally introducing the VOMRS service, a comprehensive procedure for a common Virtual Organisation management will be established. To further develop these tools is necessary since the grid middleware used by the different grid projects is diverse. We can profit from developments from German AstroGrid-D.

Task 3 – Establish a Monitoring Procedure: The use of grid resources through the Virtual Organisations requires monitoring and control. Authorisation to use grid resources through the Virtual Organisation or a Sub-VOrg implies usage limits, as projects will be competing for their share of the available resources. The information from the monitoring processes are the base for project management decisions about resource usage policies for each VOrg. Appropriate monitoring and control procedures ensure fair access to allocated resources.

Task 4 – Local/national support of connection to the EGEE infrastructure: The activity of supporting full inclusion of local clusters within EGEE requires resources. In some locations (e.g. INAF, INFN, CSIC) this task is covered by staff funded on other projects; conversely, some of the locations in AGENA expect to cover these activities with EU-provided resources. In these cases, the EU funded persons will provide installation/maintenance of EGEE for the duration of their contracts and transfer of knowledge by interacting with local engineers. In particular:

- CNRS will provide entry points to EGEE at Paris and Grenoble Observatories. Paris and Grenoble have different set-up. Paris will provide some dedicated CPUs to EGEE, while Grenoble proposes (see WP7 for full details) to extend the OAR and CIGRI middleware

to achieve interoperability with the Worker Nodes software in EGEE, and thus harnessing dynamic and heterogeneous grid resources in EGEE.
- ESA will provide an entry point to EGEE at the ESA Space Astronomy Centre (ESAC), with some CPUs dedicated to EGEE; in this case the middleware of the EGEE systems will differ slightly from the one available in the ESAC local grid, thus some extra support will be needed.

The following steps are required for building a VOrg:
- Definition of system requirements (networking with all partners)
- Assessment of certification chains, policy decisions (networking with all partners)
- Selection of appropriate VOrg management tools. Design of additional tools as required (within WP5)
- Implementation of the VOrg management system, establishment of a EU-wide Astronomy VOrg (within WP5)
- Deployment of tools and support for resource providers (within WP5)
- Monitoring and control procedure for VOrg resource usage (within WP5)
- Upgrades to the VOrg management system whenever updates of middleware occur (within WP5)

Produced documents will include contributions from all SA1 partners and will be publicly accessible on the WP5 section of the website. Such documents, however, shall not be considered as formal deliverables, but internal documentation useful for the implementation of the project. The results of the activity will be included, as for the other WPs, in the reports to be delivered to the EU; the internal documentation shall be referenced therein, and may be included as attachments.

The internal milestones defined for the WP are:

Month 5	Collection of requirements from all partners
Month 6	Design of the VOrg management system with appropriate tools
<u>Month 6</u>	<u>Virtual Organisation Implementation Plan (D5.1)</u>
Month 10	Implementation and deployment of the VOrg management system
Month 14	Implementation and deployment of monitoring and control system
<u>Month 15</u>	<u>Virtual Organisation Report and Revised Implementation Plan (D5.2)</u>
Months 13-27	Operation of the VOrg mgmt system including support for resource providers
<u>Month 27</u>	<u>Virtual Organisation Report (D5.3)</u>

1.4.3 WP6 – SA2: Support for the Porting of Applications to the Grid

Work package description

Work package number	WP6	**Start date or starting event:**		Kick-off + 3M		
Work package title	Support for the Porting of Applications to the Grid						
Activity Type[36]	SVC						
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant	12	**21**			12		

Objectives

- provide standard support to "generic" applications chosen within NA2 for their porting on the Grid.

Description of work (possibly broken down into tasks) and role of partners

- T6.1 – Set up and maintain the support infrastructure: This task aims to set up and manage a portal with a set of typical services for user support: documentation, guides, trouble ticketing system, bug tracking system, knowledge base, examples, etc.
- T6.2 – Consulting service: This task aims to analyse the proposed applications to be ported on grid, plan their deployment on the e-infrastructure, and provide personal assistance to research teams involved in porting their applications on the grid throughout the lifetime of the project

Deliverables (brief description) and month of delivery

- D6.1 – User support implementation plan (Month 6)
- D6.2 – Generic applications deployment plan (Month 6)
- D6.3– User support and generic applications deployment report and revised plan (Month 15)
- D6.4 – Final report on user support and generic application deployment (Month 27)

[36] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

This activity aims to provide support to the porting of astrophysics application on the grid environment. The leading partner of the work package, INFN, has a longstanding experience in porting scientific applications to grid. It was involved since the beginning on the definition of the computing models of the High Energy Physics experiments at the LHC collider at CERN, promoting the use of the European Grid infrastructure within the pioneers projects DataGrid and DataTAG, and then with LCG and EGEE, so that now all of the LHC HEP research activity is based on the EGEE grid platform.

INFN has also experience in porting astrophysics applications to grid, since it already collaborated within the national project Grid.It with one of the partners of the consortium, INAF. It contributed in the development of a grid-enabled prototype to access astrophysical databases and in the porting to grid of the astrophysics applications making use of them.

INAF within the Grid.It project has developed, besides the above-mentioned prototypes for database access, also demonstrators for the processing of wide-field astronomical images and for instrument monitoring. Another national project, DRACO, has specifically addressed the issue of porting astronomical applications on the Grid: working groups were created to optimise the transfer of information. The know-how built in DRACO will be very beneficial for the support activity planned in this WP, complementing INFN’s knowledge on the EGEE middleware and services with specific experience on astronomical applications.

This activity has strong relationships with the following other activities in the project:

- WP2 will select the astrophysics applications which more can benefit from their porting to the grid infrastructure
- WP4 will provide the needed training to application developers to understand the EGEE grid architecture and the better way to effectively port their applications on the grid
- WP5 will provide the grid services for the Astronomy Virtual Organisation, that will be used for run the applications
- WP7 will collect feedback from application developers about possible enhancements of the middleware to better fulfil their requirements

1.5 Joint Research Activities and associated work plan

1.5.1 JRA: General strategy

To allow the project to achieve its objectives related to the porting of complex data processing and numerical simulations applications on the Grid, allowing the interoperability of the Grid and Virtual Observatory domains, through the availability of an upgraded Grid environment, four areas of work related to Joint Research Activities have been identified: each has been made correspond to a Work Package, one dealing with the study and development of new middleware to fulfil requirements from the astronomers' community, another one to develop interoperability mechanisms between the Virtual Observatory and the Grid, and two to allow the porting on the Grid of "complex" applications: astronomical data processing and numerical simulations, respectively.

Each Work Package is under responsibility of one partner. Sub-Work Packages may be identified at a later stage, if/when required, for activities which will produce specific internal or public deliverables. Each Sub-Work Package will also be under the responsibility of one partner.

The two service Work Packages are defined as follows:

- <u>Joint Research Activities</u>
    - WP7: Development of Middleware Extensions (led by INAF)
    - WP8: Interoperability between the Grid and the Virtual Observatory (led by UCAM)
    - WP9: Grid-enabling of Astronomical Data Reduction (led by ESA)
    - WP10: Grid-enabling of Astronomical Numerical Simulations (led by CNRS)

All WPs will start immediately after the Kick-off phase of the project, in which the project detailed work program for Cycle 1 is defined..

JRA WPs (and their sub-WPs) produce respectively mid-term and final reports one month before the end of each one-year Cycle. Their reports are assessed by the Executive Technical Team which prepares respectively a mid-term and final activity report. The plan is revised at the end of Cycle 1and an updated plan is produced for Cycle 2, subject to the agreement of the Executive Technical Team and approval of the Board. A final report is produced at the end of the project.

In the following, the tables the referring to the Joint Research Activities are reported: Work-Package list, Summary of staff effort, List of deliverables. Gantt and Pert diagrams are provided, together with the List of risks and mitigation actions. The JRA milestones are indicated in the Table1.3a, section 1.3.2, which contains all of the project milestones.

Table 1.5a – Work package list

Work package No[37]	Work package title	Type of activity[38]	Lead participant No[39]	Lead participant short name	Person-months[40]	Start month[41]	End month[Errore. Il segnalibro non è definito.]
WP 7	Development of Middleware Extensions	RTD	1	INAF	103	4	27
WP 8	Interoperability between the Grid and the Virtual Observatory	RTD	5	UCAM	76	4	27
WP 9	Grid-enabling of Astronomical Data Reduction	RTD	4	ESA	58	4	27
WP 10	Grid-enabling of Astronomical Numerical Simulations	RTD	6	CNRS	135	4	27
	TOTAL				372		

Table 1.5b – Summary of staff effort

Participant number	Participant short name	WP 7 JR1	WP 8 JR2	WP 9 JR3	WP 10 JR4	Total person months
1	**INAF**	**18**	12	15		45
2	**INFN**	21				21
3	**AIP**	32		16	18	66
4	**ESA**		9	**27**		36
5	**UCAM**	27	**43**			70
6	**CNRS**	5	12		**57**	74
7	**CSIC**				60	60
-	**Total**	103	76	58	135	372

37 Work package number: WP 1 – WP n.

38 Please indicate one activity per work package:

RTD = Research and technological development; COORD = Co-ordination; SUPP = Support; MGT = Management of the consortium; SVC = Service activities.

39 Number of the participant leading the work in this work package.

40 The total number of person-months allocated to each work package.

41 Measured in months from the project start date (month 1).

Table 1.5c – List of Deliverables

Del. no. [42]	**Deliverable name**	**WP no.**	**Nature**[43]	**Dissemi-nation level** [44]	**Delivery date**[45] **(proj. month)**
D7.1	Middleware Upgrade Implementation Plan	WP7	R	PU	6
D8.1	Virtual Observatory Interoperability Plan	WP8	R	PU	6
D9.1	Data Processing Applications Deployment Plan	WP9	R	PU	6
D10.1	Numerical Simulations Applications Deployment Plan	WP10	R	PU	6
D7.2	First prototype release of upgraded middleware components	WP7	O	PU	12
D8.2	Beta release of interface software facade linking VObs and Grid	WP8	O	PU	12
D7.3	Middleware Upgrade Report and Revised Implementation Plan	WP7	R	PU	15
D8.3	Virtual Observatory Report and Revised Interoperability Plan	WP8	R	PU	15
D9.2	Data Processing Applications Deployment Report and Revised Plan	WP9	R	PU	15
D10.2	Numerical Simulations Applications Deployment Report and Revised Plan	WP10	R	PU	15
D7.4	Final validated release of upgraded middleware components	WP7	O	PU	24
D7.5	Middleware Upgrade Report	WP7	R	PU	27
D8.4	Virtual Observatory	WP8	R	PU	27

42 Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>. For example, deliverable 4.2 would be the second deliverable from work package 4.

43 Please indicate the nature of the deliverable using one of the following codes:
R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

44 Please indicate the dissemination level using one of the following codes:
PU = Public
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).

45 Measured in months from the project start date (month 1).

	Interoperability Report				
D9.3	Data Processing Applications Deployment Report	WP9	R	PU	27
D10.3	Data Processing Applications Deployment Report	WP10	R	PU	27

Table 1.5d – List of risks and mitigation actions

Risk	Consequences	Mitigation Actions
Risk JRA-R1: Joint Research Activities plan too ambitious Likelihood of occurrence=3 Impact=3 **Risk Factor = 9**	By their nature, most of the tasks within the foreseen JRAs could require more person-power, or conversely more tasks could be performed if more person-power would be available. In that case, the output of these Joint Research Activities would be limited by the funded and contributed person-power, at the risk of not achieving completely all of the Project objectives.	Joint Research Activities will then have to be prioritized by decision of the Project Board and the technical inputs from the ETT to make sure resources are directed first to what is more important. A closer check would be done by the two bodies, with the advice from the SAT, to avoid duplication of work and/or parallel developments. Additionally, partners could seek through their own funding to increase their contributed person-power to be able to cope with the extra person-power required.
Risk JRA-R2: Failure to reach coordination in the development of middleware upgrades or in the porting of complex applications Likelihood of occurrence=3 Impact=3 **Risk Factor = 9**	Partners may have different needs, requirements and priorities in defining, implementing and integrating middleware or scientific code on the Grid. That may lead to difficulties in coordinating the JRA activities among the partners and to sub-optimal use of human resources	First, it is important to notice that the diversity brought by the partners, both in scientific and technical aspects, is also to be seen as an important factor of the project. Partners bring different views, requirements and priorities which makes the European added value when they are brought together and coordinated. Through regular meetings in the context of these JRA activities, this diversity and this synergy will be discussed in order to coordinate it at European level before presenting it to other international IVOA partners. If needed, through the SAT which gives external scientific oversight and through the ETT which provides a technical evaluations, and through decision by the AGENA Board, priorities could be set to use JRA resources optimally.
Risk JRA-R3: Divergence between VObs and Grid approaches Likelihood of occurrence=1 Impact=4 **Risk Factor = 4**	Historically, VObs has developed earlier and to a certain extent independently from the Grid middleware, being oriented towards data access. Making the two approaches converge will require efforts, and divergence would mean failure to achieve interoperability between the two environments.	This risk is fairly unlikely to happen, both because VObs infrastructure developers have a strong Grid background, and because the VO-Tech and VO-DCA EU/FP6 projects are Grid-aware. On this topic, the Project shall be open to discussions with Grid developers, particularly within EGEE (a group participates in AGENA), to ensure that full information on the VObs needs is understood and proper technical means to implement the requirements are, or can be made, available.

The identified risks for the Joint Research Activities of the AGENA project have risk factors up to 9, with mitigation actions in all cases that would limit the impact of such risks. The overall level of risk of the AGENA Joint Research Activities is low.

In the following pages, the timing of the organisation for Joint Research Activities is presented as a Gantt chart, and graphical representation of the JRA components and their interdependencies is given in the form of a Pert diagram.

	WBS	Task Name	Duration	Start
34	**6**	**AGENA Cycle 1 - JRA**	**12 mons**	**Tue 01/04/08**
35	6.1	WP7, WP8, WP9, WP10 Joint Research Activities	12 mons	Tue 01/04/08
36	6.2	*D7.1: Middleware Upgrade Implementation Plan*	0 days	Fri 27/06/08
37	6.3	*D7.2: First prototype release of upgraded middleware co*	0 mons	Mon 22/12/08
38	6.4	*D7.3: Middleware Upgrade Report and Revised Impleme.*	0 mons	Thu 19/03/09
39	6.5	*D8.1: Virtual Observatory Interoperability Plan*	0 days	Fri 27/06/08
40	6.6	*D8.2: Beta release of interface software facade linking V*	0 days	Wed 24/09/08
41	6.7	*D8.3: Virtual Observatory Report and Revised Interopera*	0 mons	Thu 19/03/09
42	6.8	*D9.1: Data Processing Applications Deployment Plan*	0 days	Fri 27/06/08
43	6.9	*D9.2: Data Processing Applications Deployment Report*	0 mons	Thu 19/03/09
44	6.10	*D10.1: Numerical Simulations Applications Deployment*	0 mons	Fri 27/06/08
45	6.11	*D10.2: Numerical Simulations Applications Deployment*	0 mons	Thu 19/03/09
46	**7**	**AGENA Cycle 2 - JRA**	**12 mons**	**Wed 01/04/09**
47	7.1	WP7, WP8, WP9, WP10 Joint Research Activities	12 mons	Wed 01/04/09
48	7.2	*D7.4: Final validated release of upgraded middleware co*	0 days	Mon 21/12/09
49	7.3	*D7.5: Middleware Upgrade Report*	0 days	Thu 18/03/10
50	7.4	*D8.4: Virtual Observatory Interoperability Report*	0 days	Thu 18/03/10
51	7.5	*D9.3: Data Processing Applications Deployment Report*	0 mons	Thu 18/03/10
52	7.6	*D10.3: Data Processing Applications Deployment Repor*	0 mons	Thu 18/03/10

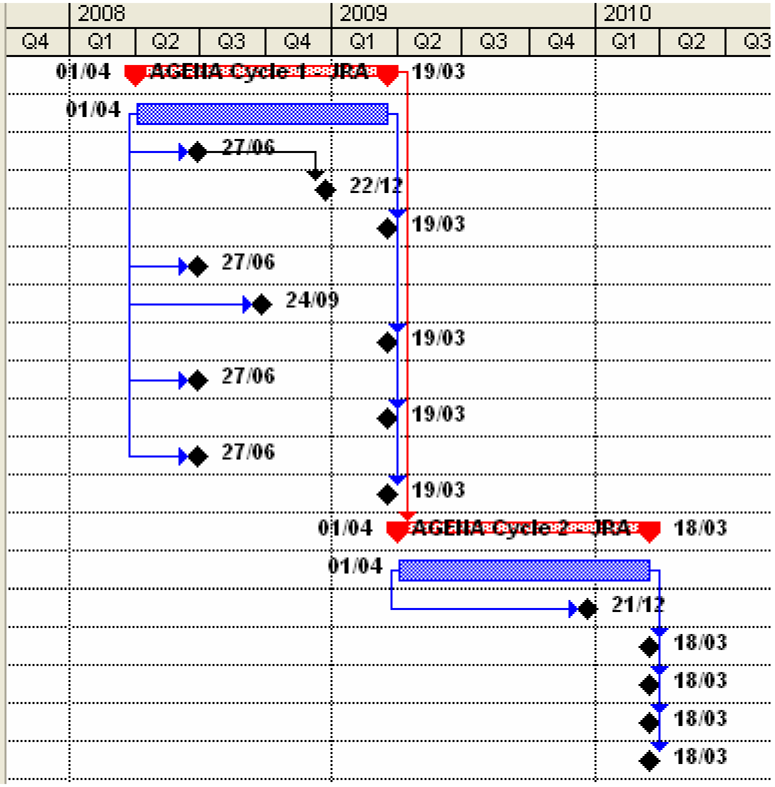

Figure 1.5.1 – JRA organisation: Gantt chart.

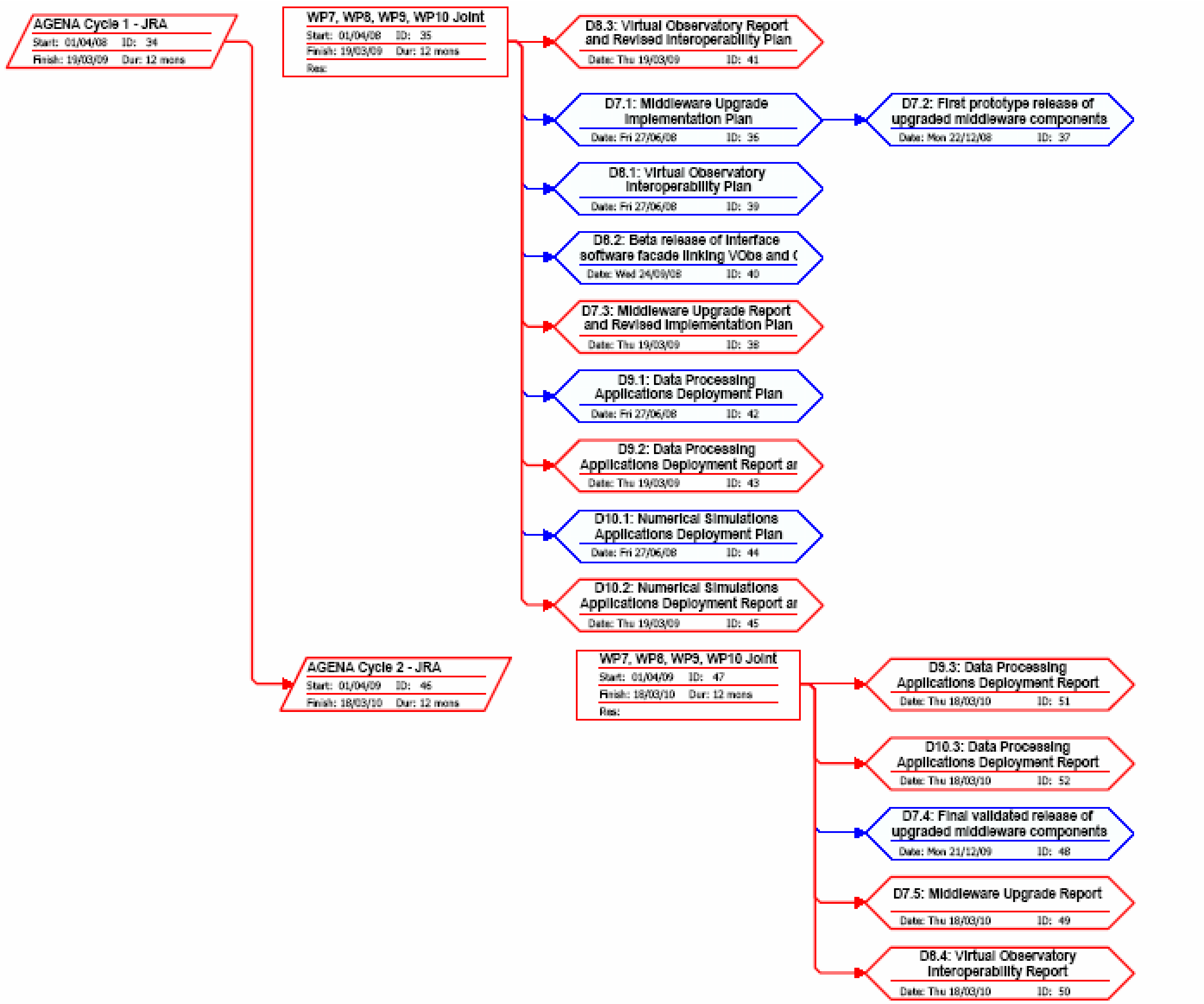

Figure 1.5.2 – JRA organisation: Pert diagram.

1.5.2 JRA1 – Upgrades to Middleware

Work package description

Work package number	WP7	**Start date or starting event:**			Kick-off + 3M	
Work package title	Upgrades to Middleware						
Activity Type[46]	RTD						
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant	**18**	21	32		27	5	

Objectives

- enhancing the present grid middleware deployed on the EGEE e-infrastructure in those areas which are identified as not completely adequate to satisfy the requirements typical of astrophysics applications (databases, data-driven computation);
- gather new requirements from WPs and, in coordination with EGEE, evaluate and possibly implement the relevant middleware upgrades;
- allow the exploitation of services available on grids based on different middleware stacks;
- investigate and possibly extend the EGEE complement of middleware and services available to the Astronomical VOrg (see WP5) by means of tools available on local or national grid infrastructures;
- investigate, and possibly perform, the extension of the EGEE middleware to other platforms (in particular Sun Solaris and the GRAPE cluster hardware).

Description of work (possibly broken down into tasks) and role of partners

- T7.1 – analysis of requirements – This task aims to collect and analyse the requirements coming from application developers and from other JRAs, and to evaluate the existing grid middleware eligible to be upgraded
- T7.2 – prioritisation and development plan definition – This task aims to rank the priorities and plan in details the activity of middleware development
- T7.3 – design and development of a prototype – This task aims to design and prototype the middleware components according with the development plan
- T7.4 – packaging, integration, testing and validation – This task aims to package the produced middleware, integrate it with the gLite distribution, and test its performance and robustness both standalone and while interacting with the other middleware components.

[46] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

Deliverables (brief description) and month of delivery

- D7.1 – Middleware upgrade development plan (Month 6)
- D7.2 – First prototype release of upgraded middleware components (Month 12)
- D7.3 – Middleware upgrade report and revised development plan (Month 15)
- D7.4 – Final validated release of upgraded middleware components (Month 24)
- D7.5 – Middleware upgrade report (Month 27)

This activity aims at enhancing the present grid middleware deployed on the e-infrastructure in those areas which are identified as not completely adequate to satisfy the requirements typical of astrophysics applications. Some of them are already known, i.e. the lack of a mature solution to intensively access large and distributed databases integrated in the EGEE e-infrastructure. Some others are expected to come from the JRA activities of WP8 (Interoperability with Virtual Observatory), WP9 (Grid-enabling of astronomical data reduction) and WP10 (Grid-enabling of numerical simulations).

It is envisaged that some effort will be spent to:

- upgrade the middleware to enable optimized data-driven computing (to bring computation where the data are);
- allow the exploitation of grids based on different middleware stacks (e.g. Globus)

With reference to the issue of accessing large and distributed databases integrated on the Grid, requirements will be gathered, while an evaluation of performances and peculiarities of three systems (OGSA-DAI, G-DSE, GRelC) will be performed on a set of astronomical databases. The results of the evaluation will be the basis to choose the system to further develop into a production-quality middleware component to be distributed to the project partners, then to the Astronomical VOrg, and contributed to EGEE for wider distribution. One of the basic activities to perform is the integration of G-DSE, which is the closest to the Grid middleware internals, with CREAM, the gLite Computing Element.

A first item to extend the EGEE services available to the Astronomical VOrg by means of tools available on local or national grid infrastructures is the Stellaris Information Service. *Stellaris*, originally developed for and currently used by AstroGrid-D, provides information on grid resources and services on the basis of W3C semantic web standards. It is well suited for a diverse grid and astronomical use cases: it is planned to provide it to AGENA and to extend its services (e.g. perform research resulting in improvements of reliability, performance and collection of results from distributed queries integrating several information sources).

For what concerns investigate and possibly extend the EGEE services by means of tools available on local or national grid infrastructures, the use of tailored web based human user interfaces, based on the *GridSphere* or *Genius* portal frameworks will be investigated, to allow smooth interaction between users and their grid-enabled applications. The aim is to reach an abstraction from the heterogeneity of the Grid by providing standard user interfaces which are independent of the actual underlying middleware, thus allowing high interoperability between different Grid environments. This includes standardised human user interfaces for Grid administrators to efficiently maintain Grid users and resources, and to monitor the availability, performance and quality of essential Grid services used in AGENA.

Ultimately EGEE-II software should not depend on specific versions of underlying software, including operating systems, compilers, interpreters etc…, and it should work on a range of hardware platforms to be selected. However, the current implementation of the middleware is only available for Scientific Linux OS, and relies on dedicated Worker Nodes, while systems developed on the Grenoble local grid operate on various Linux flavours and even on a Solaris 10 cluster. A promising exploratory task of this research activity will be to investigate the extension of the EGEE middleware also to other platforms and in particular to Sun Solaris (as available in UMS 832, Grenoble), and the integration into the EGEE grid environment of the GRAPE cluster hardware (available at ZAH/Astrogrid-D) and OAMP. Such investigations would provide challenging issues for future extension of the EGEE Grid to large non-dedicated platforms. Further re-engineering activities might exceed the scope of the present task.

The foreseen development plan is the following:

During Cycle 1, the following activities are planned: evaluation of performances and peculiarities of three systems for Grid-enabled access to databases and initial development of the chosen system into a production-quality middleware component - evaluation and initial prototyping of middleware upgrades to enable optimized data-driven computing - gathering of requirements for middleware upgrades emerging from gridification activities on general and complex applications - Stellaris base installation and documentation, analysis requirement from additional use cases and specification of new features - requirements analysis of AGENA use cases and Grid Services for GridSphere extension (requirements document, design document) - investigate the extension of the EGEE middleware to other platforms (Sun Solaris OS, GRAPE cluster hardware).

During Cycle 2, the following activities are planned: implementation and deployment of the chosen system for Grid-enabled access to databases as a production-quality middleware component - implementation and deployment of middleware upgrades to enable optimized data-driven computing - implementation and deployment of middleware upgrades required by gridification activities - implementation and deployment of upgraded Stellaris system - implementation and deployment of GridSphere portlets, initially for already available Grid services and for selected AGENA use cases, then for application-specific user interfaces for enhanced AGENA use cases, finally in production mode - prototypes for the extension of the EGEE middleware to Sun Solaris OS and the GRAPE cluster hardware.

As for partner experience needed to achieve the expected results:

INAF has developed some experience in middleware development, manages a number of sites connected to the EGEE production grid and, being an institution focused on research in astronomy, astrophysics and cosmology, is quite aware of the needs of the community in computing and access to data resources. Its main task will be to coordinate the requirements coming from the astronomers' user community and participate in the design and development of the middleware upgrades.

INFN, having the main responsibility in the middleware re-engineering activity of EGEE, has the capability to properly design, implement, test and certify the required enhancements and adaptations of the gLite middleware distribution. At the same time INFN is also a main contributor to OMII-EUROPE project, which aims to provide new middleware components enabling interoperability among the main middleware stacks deployed around the world, namely Globus, gLite and Unicore, through the adoption of standard specifications commonly agreed in the context of the Open Grid Forum.

Astrogrid-D is running a Grid based on the most current version of the Globus Toolkit (GT4) as its software platform and has also successfully produced several software elements: the "Stellaris" Information Service, Job management systems, database access using OGSA-DAI, GridSphere web portal, access to astronomical instruments. AstroGrid-D has also implemented several scientific software packages for the use with grid middleware, also using the special purpose GRAPE hardware.

The CNRS people involved in the WP7 in Grenoble participate in a collaboration with the IT team MESCAL (http://ralyx.inria.fr/2006/Raweb/mescal/uid38.html) which has developed a lightweight middleware grid software. This middleware grid software provides both a flexible resource scheduler portable on a variety of architecture, and exploits the idle CPUs of the individual clusters on a best-effort basis, constituting a dynamic grid. This simple and evolutionary concept has proven extremely efficient for running multi-parametric jobs regrouping from 10000 up to millions of individual calculations on the clusters of the CIMENT consortium (https://ciment.ujf-grenoble.fr/), and is presently experimented on the large IT-dedicated national grid Grid'5000 (http://www.grid5000.fr).

1.5.3 JRA2 – Interoperability between the Grid and the Virtual Observatory

Work package description

Work package number	WP8	**Start date or starting event:**		Kick-off + 3M		
Work package title	Interoperability between the Grid and the Virtual Observatory						
Activity Type[47]	RTD						
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant	12			9	**43**	12	

Objectives

The main objective of this work package will be to investigate the optimization of the interface between the Virtual Observatory (VObs) and the large scale computational and storage resources offered by the large European wide generic infrastructures such as EGEE and DEISA. In particular JRA2 will:

- ensure that the process of submitting jobs from the VObs infrastructure to Grid infrastructures is simplified and usable
- ensure that jobs running on the Grid be capable of receiving and returning data via a shared data grid, which in turn is accessible from the VObs via the VOSpace interface.
- ensure that the VObs is accessible to Grid users via the VObs AstroRuntime interface library
- ensure that the Authentication & Authorisation mechanisms of the VObs and EGEE allow the individual or institutional (e.g. Data Centres) users to perform a single “sign-on” to operate in both environments
- verify and implement, wherever appropriate, the possibility of layering VObs services on top of Grid middleware

Description of work (possibly broken down into tasks) and role of partners

- T8.1 – gathering of user requirements: this will occur in the start up phase of the JRA
- T8.2 – definition of system requirements: the system requirements will be issued at month 6.
- T8.3 – design of software changes to perform the porting: this represents the significant area of activity of JRA2.
- T8.4 – integration of middleware upgrades: these activities will take place in parallel with the above.

[47] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

- T8.5 – Deployment of applications: The test use cases developed through the activities of JRA2, will be used to scientifically verify the interfaces between VObs and Grid.
- T8.6 – Documentation and assessment: This will be generated toward the end of the AGENA project.

Deliverables (brief description) and month of delivery

- D8.1 – Virtual Observatory Interoperability Plan: identifications of the science driver test cases, analysis of technical requirements. (Month 6)
- D8.2 – Beta release of interface software facade linking VObs and Grid. (Month 12)
- D8.3 – Virtual Observatory Report and Revised Interoperability Plan: Draft Report sketching the technical development of interface components required to bridge the VObs and the Grid. This will generically discuss aspects such as the interface of workflows, security infrastructures, data storage, applications. (Month 15)
- D8.4 – Virtual Observatory Interoperability Report: Final Report: the draft report with proper amount of detail, and additional report from the scientific use of the VObs/Grid interface. This will be a key output of this programme, showing how, only by linking domain specific systems such as those from the Virtual Observatory to those generic compute infrastructures such as EGEE, can European research maintain its competitiveness. (Month 27)

The goals of this activity imply an in-depth analysis of the possible different approaches followed in the Grid and VObs environments to deal with basic services (Authentication and Authorization, Data management service, Job management service, Information system), and of the possibility of layering specific VObs services on top of Grid middleware.

The overall activity will be organised as follows:

1. gathering of user requirements: this will occur in the start up phase of the JRA
2. definition of system requirements: the system requirements will be issued at month 6.
3. design of software changes to perform the porting: this represents the significant area of activity of JRA2.

The VObs and EGEE grid will be interfaced through use of the gLite software infrastructure. VOSpace will be interfaced to the EGEE storage system (SRM – Storage Resource Manager) – thus allowing the movement of data from the Grid to and from the VObs. The security infrastructure will be bridged between the VObs and the EGEE.

Significantly, the VObs work-flow system (based on the OMII-Europe Taverna product) will be able to submit some grid jobs. The VObs work-flow system is rich and adds significant capability to a scientist, over and above the simple job runs possible via EGEE. In any case, there is interest in developing, maintaining and supporting workflow management tools able to interact with the Grid. Another aspect is the development of a “Data Model” to describe software modules with the aim of including them in astronomical workflows.

4. integration of middleware upgrades: these activities will take place in parallel with the

above.

There is no plan to change the existing gLite grid middleware. Rather an interface facade layer will be developed. This is because we wish to be compatible with common grid middleware. Additionally this simplifies interfaces to non-European grids and high end compute such as the USA's TeraGrid.

5. Deployment of applications: The test use cases developed through the activities of JRA2, will be used to scientifically verify the interfaces between VObs and Grid. The required applications, for instance stellar structure codes, image extraction codes and so forth will be configured on EGEE and accessed through the VObs. Work here will define activities undertaken in SA2.

6. Documentation and assessment: This will be generated toward the end of the AGENA project. Intermediate assessments will be released to the AGENA project, such that operational support of the test systems can be taken up in the work of SA1 and SA2.

1.5.4 WP9 – JRA3: Grid-enabling of Astronomical Data Reduction

Work package description

Work package number	WP9	**Start date or starting event:**		Kick-off + 3M		
Work package title	Grid-enabling of Astronomical Data Reduction					
Activity Type[48]	RTD					
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant	15		16	**27**			

Objectives

- to make astronomical data reduction packages run routinely on a computational Grid in a production environment.
- "grid-enable" selected project-specific astronomical data reduction packages, for both data access and data processing
- run selected packages in a production environment over a significant period of time to provide feedback and experience
- enable the execution of complex astronomical data processing workflows within a database federation for the data.

Description of work (possibly broken down into tasks) and role of partners

- T9.1 – identification of project-specific astronomical data reduction packages to be made grid enabled
- T9.2 – identification of system requirements to run these data reduction packages on the Grid, taking into account data access, data processing, data archiving, monitoring and error handling
- T9.3 – implementation of making grid-enabled these astronomical data reduction package
- T9.4 – routinely run on the European Grid these astronomical data reduction packages in a production mode over a very large number of datasets, in order to gain experience
- T9.5 – through a formal report, give feedback on such experience, including usage statistics, gains, lessons learned, recommendations and possibly identifying other astronomical data reduction packages to be made grid-enabled
- T9.6 – enhancement of the Process Coordinator (ProC) software suite to operate on top of the gLite middleware within the EGEE Grid environment.

[48] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

Deliverables (brief description) and month of delivery

- D9.1 – Data Processing Applications Deployment Plan; includes including System Requirements Document for the project-specific astronomical data reduction package to be made grid enabled (Month 6)
- D9.2 – Data Processing Applications Deployment Report and Revised Plan (Month 15)
- D9.3 – Data Processing Applications Deployment Report; includes Reporting about running the astronomical data reduction package on the Grid (Month 27)

Note: The Project-specific astronomical data reduction package(s) made grid enabled will be included in the first version of the AGENA Software repository (D2.4, Month 17)

The objective of JRA3 is to make astronomical data reduction packages run routinely on a computational Grid in a production environment. Two main areas will be looked at: one about running a major space project (most probably ESA´s Herschel Space Observatory) pipeline onto the GRID and the other about porting existing astronomical application (ProC and AIPS) onto the Grid.

(a) running a major space project pipeline onto the GRID

By selecting a project-specific astronomical data reduction packages, work will be done to make them “grid-enabled” for both data access and data processing. Running it in a production environment over a significant period of time will allow to make use of the European Grid as well as to provide feedback and experience on this exercise. This could then “pave” the way for other project-specific or more generic astronomical data reduction package to be made grid-enabled.

Ground based and space based projects have developed data reduction pipeline to transform “raw data” coming from the telescope or the satellite into scientific data that can be distributed to the scientific community. This is an essential process of all astronomical projects to ensure the scientific return of its project. In particular for space based missions, scientific institutions and international organizations have developed such pipelines and are routinely processing the raw data before archiving it and distributing to its users. Due to the increased complexity of the instruments and their detectors, the computer needs to perform this data reduction does require increased computational capabilities.
Various processing concepts can be used: an iterative processing on a big amount of data or a parallel processing on small chunks of data (usually based on observational day). Both concepts can easily benefit from the computational Grid concept where many computing nodes are made available.

Traditionally, these projects have run their data reduction pipeline on local computer clusters, but with the increased needs for computer power, it has become evident that the Grid concept would be the only way to deal with this processing requirements in the future. Furthermore, the projects can benefit from the Grid middleware that has been developed by the Grid experts and therefore these projects can concentrate on the astronomical data reduction software where they have the full expertise.

In the case of projects like Herschel, data has to be processed on a routine daily basis (*standard processing*) when data comes down to the ground from the satellite. This data is then saved into the archive so it can be distributed to the end user.
Nonetheless, the data reduction pipeline improves regularly as calibration scientists understand better their instrument behaviour. That leads to new version of the pipeline software but makes obsolete the quality of the previously processed data. Therefore, the archive can offer *on-the-fly reprocessing* so the user can request from the archive the reprocessing of the raw data into scientific products using the latest version of the pipeline software.
Regularly, every year or two, it can be interesting to reprocess all raw data from the beginning of the mission (*bulk-reprocessing*) to generate a complete full set of the scientific products with a unified version of the pipeline software.

All these types of processing (standard processing, on-the-fly reprocessing and bulk-reprocessing) can take place at the same time multiplying the needs of the computing capabilities.
At the beginning of the mission, only standard processing takes place, so limited amount of computing capabilities is required.
When a new version of the pipeline software is available, standard processing and on-the-fly reprocessing will take place simultaneously, so more processing capabilities is required.
When bulk reprocessing takes place, all three types of processing take place at the same time creating the highest peak of computing power needs.
Once bulk reprocessing is completed, only standard processing will take place, so the computing power needs comes down, until a new version of the pipeline software is released and the whole cycle starts again.
This model describes quite well the needs for the projects to have access to computing power "on-demand" depending of the phases of the project. The projects has then interest to get access to external Grid infrastructure so they can get access to more computing power when they need it (on-the-fly and specially bulk-reprocessing phases).
Instead of running all these tasks on a local cluster, projects should be motivated to build their Grid to cope with their standards activities but join their Grid to a more global Grid (e.g. EGEE) to they can share their resources when they are not used and benefit from the other Grid resources when they need it.

Running astronomical data reduction pipeline on a Grid infrastructure will raise many challenges which will have to be addressed, prototyped and solved in the context of this JRA3.
The challenge of installing the project data reduction pipeline could be solved by installing this pipeline software on all the Grid nodes of the corresponding Virtual Organization of the AGENA project. Nonetheless, it would be interesting also to investigate how this data reduction pipeline could be sent and installed on-demand on remote Grid nodes. That would allow to run these pipeline tasks on other VOrg Grid nodes without requiring to have the application pre-installed there.
An other challenge to be looked at is transportation of the raw data to the Grid node when it will be processed; as well as sending back the processed data to the project archive for its further ingestion. This could be coordinated with activities taking place in JRA1 where Virtual Space will be investigated. One will also have to look into the overhead about

transporting the data back and forth when the amount of data can be quite large so the time for transporting the data may be too big with regard to the time required for processing the data. Benchmarking should be made to find out when does it become interesting to run such tasks, which can depend on the number of Grid nodes accessible to which tasks can be sent in parallel.

That will naturally lead to prioritization and optimization of these tasks to make sure that processing tasks with big amount of data are sent to local Grid in priority while tasks with small amount of data will gain in being sent to remote Grid nodes. Furthermore, projects must still ensure the availability of their own Grid resources for their routine data reduction tasks (standard processing and on-the-fly reprocessing having the highest priorities) while they have to accept the sharing of their local Grid resources in order to be able to use the remote Grid resources of the VOrg they belong to.

Last but not least, the security challenge will also have to be looked into as this data is usually proprietary when they are first processed in the standard processing case. Some secure way will have to be found when transporting this raw data and even more important when sending the resulting scientific data.

(b) porting AIPS and ProC onto the GRID

Science and telescope simulations are essential to define a Square Kilometre Array which has the capability to carry out the Key Science projects defined as the main goals of the SKA. The use of the grid can be a great help in the massive solution of the following technical and design simulation problems:

- array configuration
- best uv-plane coverage
- Study of the beam forming algorithms,
- multi-beam,

This work can be made starting from the “Figure Of Merit” (FOM from Swinburne University) and “MIT Array Performance Simulator” (MAPS)

Moreover the porting on the grid of “kernels” of the radio-astronomical data reduction packages (CASA, AIPS- with-ParselTongue) can give as efficient tools to simulate the SKA images obtained with thousands of different configurations and parameters. The performance of these applications can be evaluated on different architecture (i.e. grid, cluster) to study the bottlenecks of the “real clusters” in the radio-astronomical applications.

The identification of project-specific astronomical data reduction packages to be made grid enabled will be performed as part of the project plan. It is in any case to be noted that Grid-enabling the radio-astronomical software AIPS would be a definite plus for the LOFAR and SKA radio-astronomy community.

As for enabling the execution of complex astronomical data processing workflows within a database federation for the data, the aim is to import Cosmic Microwave Background data analysis software, specifically Planck/CMB simulation workflows, into the EGEE environment. We want to particularly exploit the sophisticated data management infrastructure available within EGEE.

The experience with these two pilot projects will further help with the grid integration of the data processing needs from other astronomical communities. This will be an extension of the work currently being carried out within the D-GRID/AstroGrid-D project (AIP/MPA).

Task 1: Integration the Planck Process Coordinator (ProC) workflow engine into the EGEE Grid environment

(1) developing a suitable deployment mechanism into EGEE that includes the deployment of the non portable scientific modules;
(2) developing a mechanism for continuous integration;
(3) setting up suitable tests for the ProC operating on top of the gLite middleware;
(4) enhancing the reporting mechanism of the ProC to cope with external Grid information systems;
(5) Training and Support (see Work Package 4).

Task 2: Integrate the ProC Data Management Component into the EGEE Grid environment
Task 3: Import the AIPS package into the ProC, thereby grid-enabling AIPS by using ProC's novel simple wrapper mechanism to import all AIPS tasks into the grid-enabled ProC
Taks 4: Set-up a distributed software infrastructure for near real-time processing of LOFAR data streams by enhancing the ProC so that it may process streaming modules.
Task 5: Carry out and support scientific projects comprising LOFAR key science projects such as the analysis of the epoch of reionization and magnetic fields.

1.5.5 WP10 – JRA4: Grid-enabling of Numerical Simulations

Work package description

Work package number	WP10	**Start date or starting event:**			Kick-off + 3M		
Work package title	Grid-enabling of Numerical Simulations						
Activity Type[49]	RTD						
Participant number	1	2	3	4	5	6	7
Participant short name	INAF	INFN	AIP	ESA	UCam	CNRS	CSIC
Person-months per participant			18			**57**	60

Objectives

- porting to the Grid several numerical simulations related to astronomy, astrophysics and cosmology;
- running the ported numerical simulations in production mode;
- feedback to WP7 through ETT to set requirements on middleware and design of new software to perform the porting of codes;
- trans-national pool of "good practice" for the use of the Grid for numerical simulations.

Description of work (possibly broken down into tasks) and role of partners

- T10.1 – gathering of user requirements (all JRA4 partners)
- T10.2 – definition of system requirements (networking with all partners)
- T10.3 – design of software changes to perform the porting
- T10.4 – integration of middleware upgrades (if relevant) at each entry point to EGEE by WP5
- T10.5 – deployment of application (all JRA4 partners)
- T10.6 – testing vs requirements (all JRA4 partners)
- T10.7 – benchmarking (all JRA4 partners)
- T10.8 – production mode (all JRA4 partners)

Deliverables (brief description) and month of delivery

- D10.1 – Numerical Simulations Applications Deployment Plan
- D10.2 – Numerical Simulations Applications Deployment Report and Revised Plan

[49] Please indicate one activity per work package:
RTD: Research and technological development; COORD: Co-ordination; SUPP: Support; MGT: Management of the consortium; SVC: Service activities.

- D10.3 – Data Processing Applications Deployment Report

Several numerical simulations related to astronomy, astrophysics and cosmology will be ported to the Grid. These deployments will eventually be running in production mode taking advantage of the Grid technology. Meanwhile the whole process will generate design of new software to perform the porting and generally will benefit the EGEE community thanks to the inclusion of new requirements to the middleware. Codes will be ported in 3 different countries, thus creating a trans-national pool of "good practice", that will serve as model examples to a wider astrophysical community.

Technical Description
We chose numerical simulations from very different fields, the codes are structured in different ways, their input, output requirements are different as well as their optimisation with respect to computing facilities. At stage 1 each partner will gather the user requirements for the chosen codes, this will lead to the definition of system requirements in connection with NA2 (WP2) and to the design of software changes to perform the porting.. Integration of middleware upgrades (if relevant) will be coordinated with SA1 (WP5). The applications will then be deployed with a intermediate phase of testing versus requirements, followed by a benchmarking phase in order to assess the usefulness of the grid technology versus other computing facilities. Final point will be the production mode with achievement of important scientific results.

1. gathering of user requirements (all JRA4 partners)
2. definition of system requirements (networking with all partners)
3. design of software changes to perform the porting
4. integration of middleware upgrades (if relevant) at each entry point to EGEE by WP5
5. deployment of application (all JRA4 partners)
6. testing vs requirements (all JRA4 partners)
7. benchmarking (all JRA4 partners)
8. production mode (all JRA4 partners)

Scientific Interest
The scientific Interest of the numerical simulations proposed in this WP are detailed in Appendix B.

Internal Milestones
Internal Milestones indicate steps that need to be taken in order to produce the deliverables of WP10. Those milestones will include contributions from all JRA4 partners, those will be provided by the WP10 contact points of partners 3, 6, 7. The final documents will be compiled by JRA4 leader (partner 6) and will contribute to write the deliverable reports.

Month 2: List of user requirements provided by each partner of JRA4 and compiled by leader of JRA4 to produce a " JRA4 User Requirements" document.

<u>Deliverable D10.1 on month 3</u>

Month 7: List of system requirements provided by each partner of JRA4 and compiled by leader of JRA4 to produce a " JRA4 System Requirements" document. This document will be transmitted to Executive Technical Team for evaluation.

Month 12: After integration of middleware upgrades and deployment of application: Results of "Testing vs Requirements" are provided by each partner of JRA4 and compiled by leader of JRA4 to produce "JRA4 Testing vs Requirements" document.

Month 14: Leader will check with partners whether new software is needed and transmit information to Executive Technical Team for evaluation.

Deliverable D10.2 on month 15

Month 17: Results of benchmarking are provided by each partner of JRA4 and compiled by leader of JRA4 to produce a “JRA4 benchmarking” document (regularly updated).

Month 20 onwards: Depending on relative progress in WP10, some results about production mode will be regularly gathered by leader among partners in a “ JRA4 Production Mode Progress Reports” document.

Deliverable D10.3 on month 27

Section 2. Implementation

2.1 Management structure and procedures

The foreseen programme of work calls for an efficient management structure, designed to deal with all administrative and technical aspects of the project. Especially concerning the technical aspects, the focus is on allowing the project to deliver the services needed to support both Partners and external users needing to solve their specific capacity computing problems. This is considered fundamental for the build-up of a community of users capable of taking advantage of the developed know-how and of exploiting it for their own specific goals.

2.1.1 Management structure

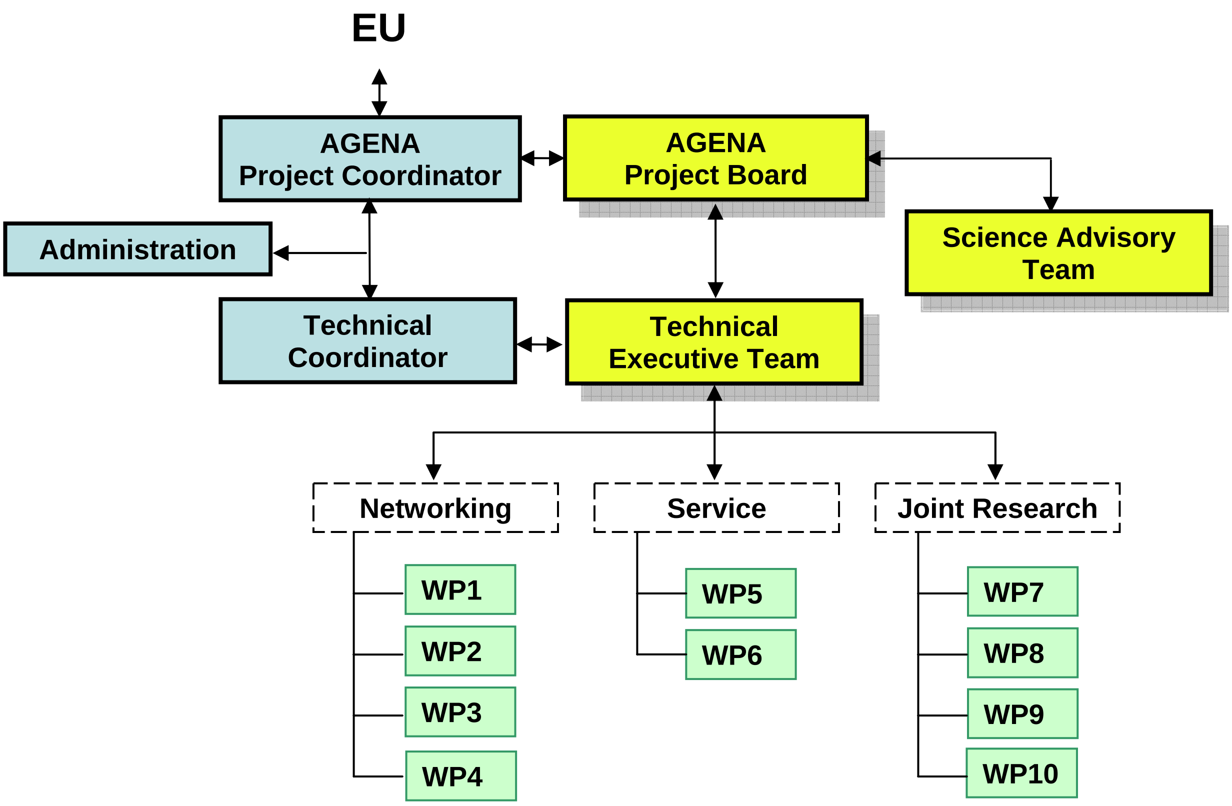

Figure 2.1.1

The variety of tasks to be carried out within AGENA requires enough flexibility to handle on one side the different challenges deriving from the specific Joint Research Activities and, on the other side, the new and sometimes unexpected problems most likely to arise from the support activity the project will provide for the community at large. At the same time, a good level of coordination will be needed to allow harmonisation and control both over the development of research activities and the provision of services.

The management scheme is depicted in Figure 2.1.1.

The Project Coordinator, appointed by the lead Partner, coordinates AGENA and is delegated by all Partners to represent the project with the EU; for all financial and administrative aspects he/she will be supported by an Administrative Officer.

The Technical Coordinator is also the Project Coordinator's deputy and is in charge of the overall coordination of the various technical activities.

In the Project Board each Partner is represented by one member (usually by the coordinator for the Partner institution within the project). The Board is in charge of taking administrative decisions and strategy choices involving all Partners; the scientific strategic direction of the project will be implemented by the Project Coordinator in agreement with the Project Board. The Board will be composed of members nominated by the partner institutions. Each partner will appoint a member and can appoint up to two deputies; in any case, only one participant per institution will participate, with voting rights, in the Board meetings The Project Coordinator will represent the lead Partner, and will chair and manage the Board. The Administrative Officer supporting the project and the Technical Coordinator will have a standing invitation to participate in the meetings.

The Executive Technical Team includes the leaders of all WPs: the International Coordination and Dissemination (WP3) and Training (WP4) activities, the Virtual Organisation (WP5) and Applications Integration (WP6) support activities, and all Joint Research Activities (WPs 7, 8, 9, 10). The ETT will be chaired by the AGENA Technical Coordinator. In case of need, each WP leader may be represented at Team meetings by a nominated deputy with voting rights. The Executive Technical Team is the core of the management structure from the technical point of view and is planned to be quite operative. It will be chaired by the Technical Coordinator, it will meet monthly and ensure the technical management of the project, by making sure that the project WPs have a common view. Furthermore, it will appropriately advise the Project Coordinator on the technical validity and relevance of the project strategic plans. The Project Coordinator will have a standing invitation to participate in the meetings.

The WP3 leader is nominated as the Dissemination Manager and is in charge of bringing to the external community the AGENA activities, findings, lessons learned, on-line help, etc., cooperating when relevant with other national or international projects. Public presence will also be assured through relations with the media, promotional material, presentation of the project (activities, demos, results) during conferences and workshops.

The WP4 leader is nominated as the Training Manager and is responsible for organising two classes of tutorials and training courses: a) for application developers and site managers about EGEE middleware and its deployment on local computing resources, b) for users and application developers specifically on the porting of astrophysical applications to grid, and on the available tools and services.

The WP5 leader is nominated as the Infrastructure/Service Manager and coordinates all activities related to the Virtual Organisation(s) generated by the project and liaise with the EGEE operations staff for all relevant aspects.

The WP6 leader is nominated as the Application/Integration Manager and coordinates all activities related to the support given for the porting of generic applications on the Grid, and will liaise with both EGEE support staff and with the leaders of the Joint Research Activities for all relevant aspects. He/she will be responsible for guiding users in migrating their applications to the Grid infrastructure and identify new requirements.

The composition of the Executive Technical Team is shown in Figure 2.1.2.

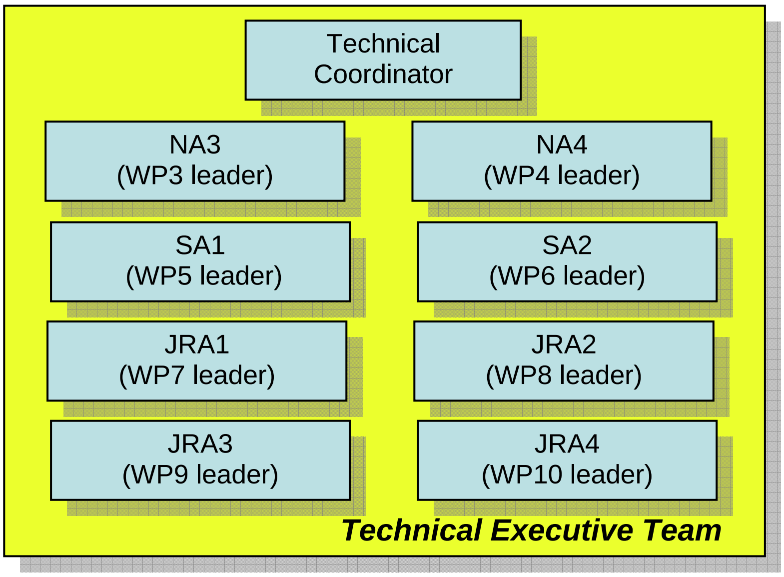

Figure 2.1.2

The Science Advisory Team is a panel appointed by the Project Board, composed of scientists nominated one each by the partner teams. Its role is to check the global scientific coherence of the AGENA activities. The Team members will elect among themselves the Project Scientist. He/she will organize SAT teleconference discussions whenever necessary, in particular if SAT advice is required by one of the project Work Packages. The Project Scientist will report on the Science Advisory Team activities to the Project Board.

To minimise costs, meetings will be held via teleconference whenever appropriate, although at least three meetings of each group are planned to be face-to-face.

2.1.2 Management procedures

Figures 2.1.3, 2.1.4 and 2.1.5 illustrate the coordination process, which is described in the following.

The Joint Research Activities involved in the porting on the Grid of “complex” applications (WPs 9 and 10) and in the interoperability between the Grid and the Virtual Observatory (WP8) perform their work using the available middleware.

At the same time, scientists from the astronomical community may, as a response to calls issued regularly, propose their codes as “generic” applications to be ported on the Grid. The proposals are submitted to the Executive Technical Team, which performs a technical estimation of the resources necessary to support the porting and forwards the information to the Board. The Board, as part of the WP2 (strategy) activities, evaluates the proposals and issues a prioritized list of “generic” applications to be supported by the project. The Executive Technical Team finally assigns the proposals to be supported to the WP6. The porting on the Grid of each “generic” application is carried out in close interaction between the proposing team and WP6. These relations are marked as red arrows in Figure 2.1.3.

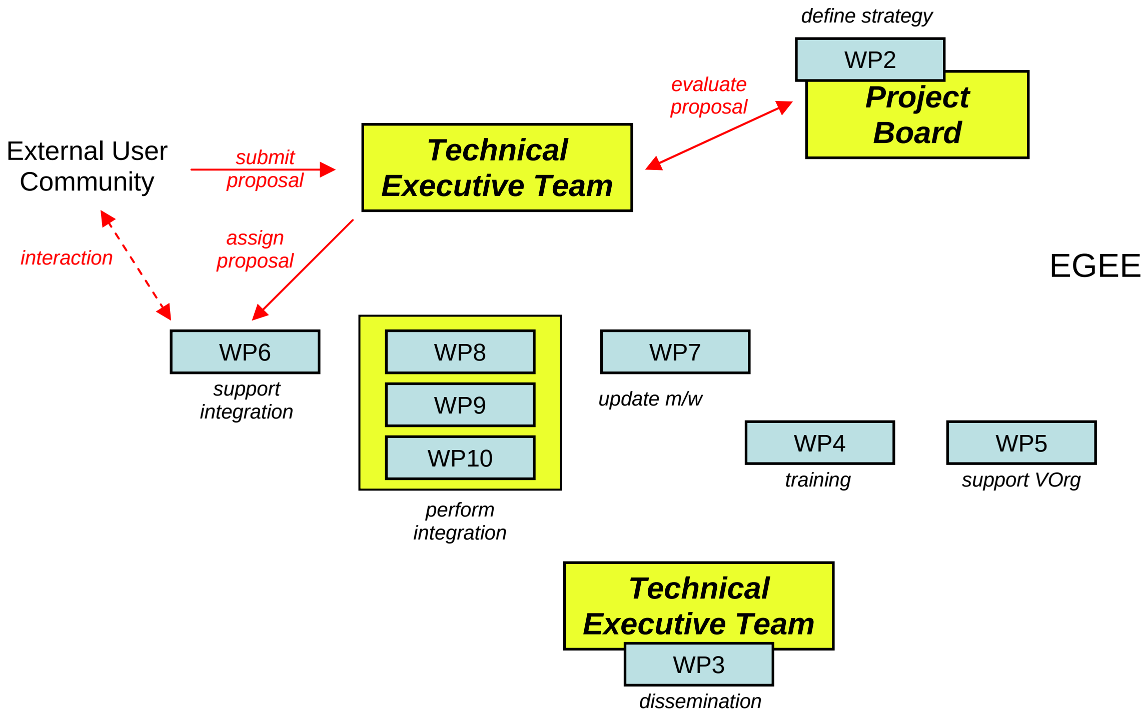

Figure 2.1.3

As a result of the porting activity on both "complex" and "generic" applications, and of the development of Grid-VObs interoperability tools and procedures, new requirements on the middleware are bound to arise. Such requirements will be submitted to the Executive Technical Team, which will evaluate them and scale them by complexity. Subject to the approval of the Board, some middleware updates of reasonable complexity will be assigned by the Executive Technical Team to WP7, after discussion and negotiation with the WP leader within the Team itself. To avoid duplication of efforts or other waste of person-power, the possible assignment and the implementation of the development activities will be carried out in close coordination with EGEE, and in particular with the Middleware Manager of the EGEE-II Project Executive Board. When the middleware updates are ready (implemented and tested against requirements), their are delivered to the Executive Technical Team for distribution to the various work-packages and for feedback to EGEE. These relations are marked as green arrows in Figure 2.1.4.

Close coordination with EGEE (with the appropriate activity groups) will be pursued for implementation of the WP5 (support of the Virtual Organisation) and WP4 (training). Both activities are of course coordinated within the AGENA ETT. In Figure 2.1.5 such coordination relations are marked as short-dashed blue arrows, internal training as long-dashed purple arrows.

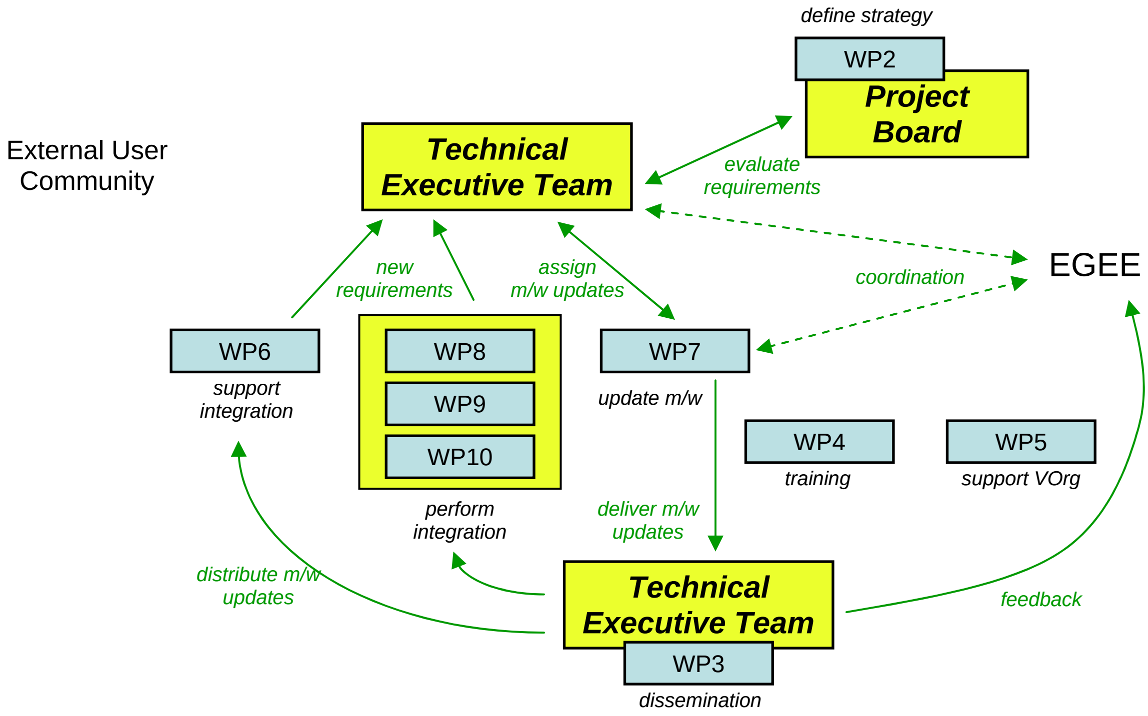

Figure 2.1.4

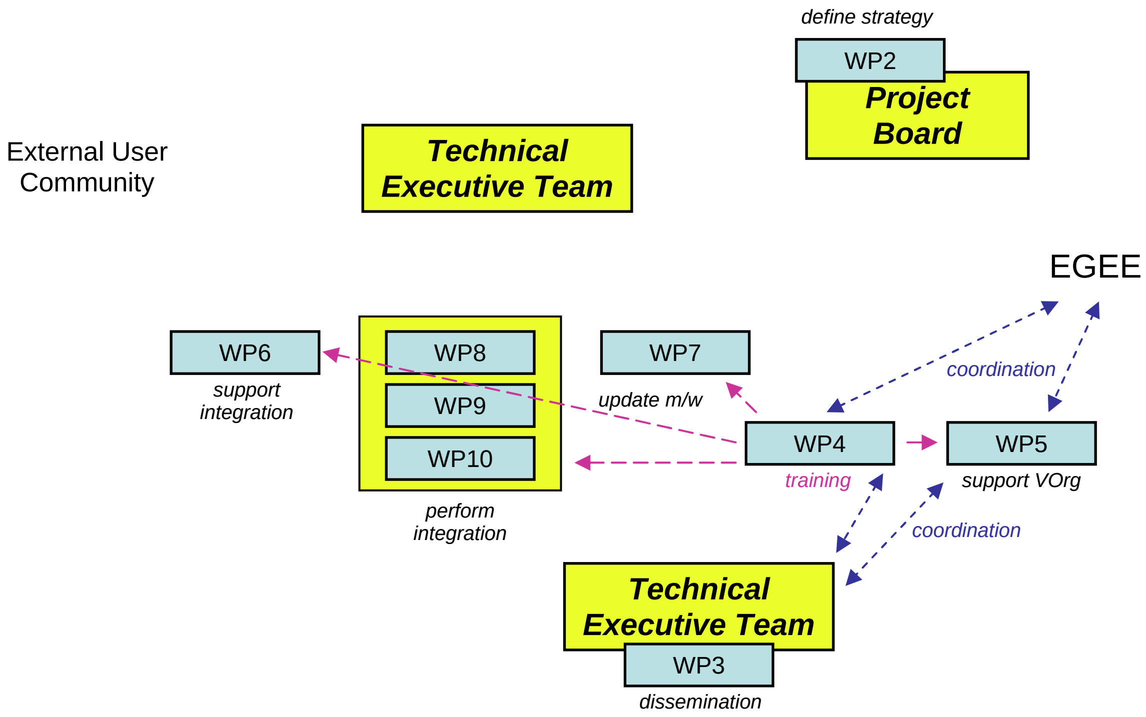

Figure 2.1.5

2.2 Individual participants

2.2.1 INAF

INAF is the Italian institution coordinating research in astrophysics. It is composed of a total of 22 between Astronomical Observatories and Institutes, geographically distributed over the national territory, and of the "Galileo" observing facility located in La Palma, Canary Islands. INAF has been active for over six years in the fields of grid technologies (deployment of infrastructure and integration of domain-specific applications) and archives of astronomical data (from both ground-based and space-borne facilities).

In this project, INAF has the responsibility of the overall management of the Consortium, and leads the work-packages "Project Coordination and Strategy" and "Development of Middleware Extensions", with participations in other support and research activities.

Within the *Grid.it* national project for the deployment of a research grid, in the "Applications" activity (coordinated by INFN), a dedicated work-package has tackled the issues of Grid-enabling astronomical applications. As part of this activity, some prototype middleware was developed (in collaboration with INFN) to allow "Grid-native" access to databases (using Virtual Observatory standards), and monitoring of astronomical instruments using Grid techniques.

A separate project (*DRACO*) was funded by the Ministry of Education and Research to allow the porting of astronomical applications on the Grid. This allowed the Italian astronomical community to build and support on the GILDA Grid test-bed its own Virtual Organisation. An extension of the project called *DRACO-2* has been recently funded by INAF.

Within EGEE, INAF scientists manage the Planck Virtual Organisation (VOrg), created after the porting to the Grid of numerical simulations of the Planck mission was approved by EGAAP in November 2004; INAF participates (as unfunded partner) in the NA4 work-package of EGEE-II, with the task of coordinating the integration of astronomical applications.

INAF furthermore participates in regional consortia aimed at building and managing computational grids for scientific and industrial applications: the *TriGRID* Virtual Laboratory project, funded by the Sicilian Regional Government using funds from EU (Objective 1 area), and *CyberSar* and *PI2S2* funded by the Italian Ministry for Research.

It is furthermore to be noted that, in the *VO-DCA* project, funded under EU/FP6, INAF leads the "Coordination with the computational grid" work-package having the purpose of achieving coordination between the Virtual Observatory and the computational grid communities, and studying and evaluating interoperability between Grid and VObs. INAF leads *VObs.it*, the Italian Virtual Observatory project, member of Euro-VO.

The INAF sites of Trieste and Catania are nodes of EGEE, providing several dozens of CPUs.

Furthermore, there is specific experience in training: e.g. in 2007 two international schools were organised in Trieste, one related to the porting of astronomical applications on EGEE, one about scientific instruments and sensors on the Grid.

INAF key staff are:

Fabio Pasian will be the AGENA Project Coordinator. Senior astronomer at INAF-OATs, he directs the INAF Information Systems Unit, and among other duties has the responsibility of coordinating data archiving and distributed computing throughout the INAF sites. PI of the DRACO project, he is the Italian representative in the International Virtual Observatory Executive Committee and in the VO-Tech and VO-DCA projects funded by EU/FP6. He also covers the role of PA Manager in the Planck LFI Data Processing Centre.

Claudio Vuerli will be the AGENA Technical Coordinator of the project. Permanent staff astronomer at INAF-OATs since 1990. Technical leader of DRACO and head of the DRACO-2 project, he is the EGEE/NA4 reference person for astronomy. Co-director of the International "Workshop on Scientific Instruments and Sensors on the Grid", he is the organiser of the Astro Workshop at the 2007 EGEE User Forum.

2.2.2 INFN

The Istituto Nazionale di Fisica Nucleare (http://www.infn.it/), is an Italian public governmental research organization, which promotes, co-ordinates and funds nuclear and high-energy physics related researches. It is organized in 4 National Laboratories, 19 Departments (called Sections located in major Universities) and 11 Local Groups (see http://www.infn.it/mappa.php). INFN staff research personnel amounts to more than 1500 peoples with an equivalent number of associates from University and other Scientific National Institutes. INFN has a considerable experience on high performance distributed computing. Already in 1998 INFN deployed a Wide Area CONDOR Pool distributed all over Italy (see http://www.infn.it/condor); at the end of 1999 INFN launched the INFN-GRID project (http://www.infn.it/grid), to evaluate/develop the use of Grid technologies in facing the stringent computing requirements of the High Energy incoming LHC experiments at CERN. Since 2001 INFN has played a major role in the EU DataGrid and DataTAG projects, the CERN based LCG and WLCG projects, the National Grid Projects Grid.It (http://server11.infn.it/firb-grid) and LIBI, and more recently the EGEE and EGEE II and the grid infrastructure extension projects like EUmedGRID, EUChinaGRID, EU-IndiaGrid and EELA, GridCC and BioinfoGRID The INFN contribution to these projects comprises the setup of the INFN Production Grid, with more then 3000 CPU's deployed in more than 20 sites, the development and reengineering of the grid Middleware, in particular of the Workload Management service, the Virtual Organization Membership Service (VOMS), the Glue Schema, the new Web Service CE implementation with CREAM and CEMON, the Grid Accounting service DGAS, the Grid Monitoring service GridICE, some new components related to grid policies GPBOX and the SRM interface to parallel file systems (Storm) together with the dissemination ad training activities.

Role in the project:

INFN main tasks in AGENA will be the participation and coordination of the NA (training) and SA (applications' and users' support) activities. INFN will also take part to the JRA activities concerning the upgrade of the middleware as required from the Astrophysics community.

Experience to carry out this task comes from the role played in the various worldwide Grid projects quoted above and from the role that INFN has in the EGEE projects. Moreover the experience coming from the coordination of the INFN Production Grid (the INFNGRID) will be of utmost importance in running and coordinating the users' and applications' support infrastructure needed by AGENA. Furthermore INFN has an important role in the development of Grid software and has extensive knowledge of the problems related to testing and certification activities.

Main Staff Members involved:

Mirco Mazzucato: Present position: INFN Director of Research. CNAF (INFN Advanced Computing Centre) Director, since 2004. INFN Grid Project Project Manager since 2000. INFN delegate and member of the Management Board in the (W)LCG, World Computing Grid for LHC Computing Grid Project at CERN since 2002 (~ 6000 physics in Europe, USA and Asia) Member of the Project Management Board and coordinator of the Italian Federation in the FP6 European project EGEE (and its successor EGEE II) MIUR Italian delegate in the e-Infrastructure Reflection Group.

2.2.3 AIP, representing Astrogrid-D

Building on a tradition of 300 years from one of the oldest astronomical institutions in the world, the AIP is today one of the four important centres of astrophysical research in Germany. Areas of research cover most topics of modern astrophysics: starting with solar observations and magnetohydrodynamic theory this includes stellar spectroscopy and evolution as well as galaxy formation and cosmology. The AIP participates in a high number of international cooperations including some of the most challenging projects of current and future astrophysics.
In recent years the AIP strengthened its research in instrumental and computational astrophysics and e-Science. Internationally it has gained a top standing in the development of 3D and high resolution spectroscopic instruments (PMAS, MUSE, PEPSI). The AIP hosts three robotic telescopes locally and on the Canary Islands and has developed the software for autonomous observation. The AIP operates several compute clusters with a total of almost 200 dual- or quad CPU nodes. Together with the university of Potsdam it is also engaged in educational courses on supercomputing.
In the e-Science segment the AIP is a founding member of the German Virtual Observatory project (GAVO, www.g-vo.org). One of the main activities here is the VObs-compatible distribution of the RAVE data survey ("Radial Velocity Experiment") that the AIP leads. This depicts the most extensive survey to measure chemical abundances and radial velocities of a million stars in the milky way. The AIP also chairs the current German AstroGrid-D initiative (also described in section 1.2). Its participation in that initiative consists of the administration and project leading, the grid integration of the AIP's robotic telescopes and its other computing hardware resources and storage facilities. One of the main projects is the development of virtual organisation management tools.
AIP key staff members for this project:
Matthias Steinmetz, director of the AIP and consortium manager of the AstroGrid-D project.
Detlef Elstner, head of eScience at the AIP.
Harry Enke, senior research physicist and project manager of the AstroGrid-D.
The AIP will serve as the project contact for four other German institutes that will add their experience and co-develop applications for the AGENA project:

Acro-nym	*Institute Name*	*City*	*Key Staff Members*
AEI	Max-Planck-Institute for Gravitational Physics – Albert Einstein Institute	Golm	Thomas Radke
MPA	Max-Planck-Institute for Astrophysics	Garching	Torsten Ensslin, Hans-Martin Adorf
ZAH	Centre for Astronomy of the University of Heidelberg	Heidelberg	Rainer Spurzem, Jürgen Steinacker (colla-boration with E. Athanassoula, OAMP, CNRS)
ZIB	Zuse Institute Berlin	Berlin	Mikael Högquist, Thomas Röblitz, Alexander Reinefeld

2.2.4 ESA

The European Space Agency is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens in Europe. The Science Programme is the only mandatory element of the ESA programme, and is therefore both a flagship and symbol for the Agency. It enhances European capability in space science and applications, builds European industrial technical capacity, and brings together European national space programmes.
ESA's centre in Spain, the European Space Astronomy Centre (ESAC), is the default location for the Science Programme's astronomy and planetary science operations. ESAC holds the associated archives (currently, ISO, XMM-Newton, INTEGRAL, Mars Express, Rosetta, Giotto, Huygens, etc and in the future Herschel, Planck, Gaia, Venus Express, etc). For some of its projects (eg Herschel, Gaia), ESAC will be in partly or completely in charge of the routine data processing. In that context, ESA astronomical Grid activities are taking place at ESAC through the ESAC Computer Support Group (responsible of all scientific computing facilities at ESAC) in close cooperation with the ESAC Science Archives and Virtual Observatory Team (responsible of the scientific archives and Virtual Observatory activities at ESAC).

ESAC key staffs for the project are:
Christophe Arviset, senior system engineer, is the leader of the ESAC Computer Support Group and Science Archives and Virtual Observatory Team. On one side, his teams are in charge of providing computer infrastructure and support (including Grid) to the Science Operations Centres at ESAC. On the other side, his teams are responsible in designing, developing and operating projects scientific archives. As the ESAVO project manager, he ensures that ESA scientific archives are accessible through the Virtual Observatory framework and represents ESA at the International Virtual Observatory Alliance and EURO-VO.

Ruben Alvarez, senior computer system engineer, is the technical coordinator of the ESAC Computer Support Group. His responsibilities include the technical coordination of the team of computer system analysts taking care of the entire scientific computing infrastructure at ESAC, as well as all the Grid activities.

Pedro Osuna, senior archive system engineer, is the technical coordinator of the ESAC Science Archives and Virtual Observatory Team. His responsibilities include the technical coordination of the team of software engineers taking care of the scientific archive development and operations, as well as the technical coordination of ESAVO project activities. He is heavily involved in the International Virtual Observatory Alliance activities (being the chair of the VObs Query Language working group) and in the EURO-VO activities in Europe.

2.2.5 UCAM, representing the AstroGrid Consortium

The University of Cambridge enters the project on behalf of the **AstroGrid Project**, which is a consortium of six UK Universities and Public Laboratories who collaborate within the UK to take forward the Virtual Observatory agenda. The other members are Edinburgh, Leicester, Manchester, University College London, and Rutherford Appleton Laboratory. AstroGrid has a particular focus on development of the technical infrastructure necessary for the VObs, such as Virtual Storage, Authentication, API, Workflow systems, and grid and web service interfaces, as well as development of the related standards. For that reason AstroGrid is acknowledged as the lead partner within the Euro-VO Technology Centre (VOTC), and is the coordinating partner for the FP6 VOTECH project. The AstroGrid project, along with CDS, ESO, and the US-NVO, was a founding member of the International Virtual Observatory Alliance (IVOA).

The **University of Cambridge** is a major European University. It hosts a leading Astronomy research cluster including the Institute of Astronomy. The Institute of Astronomy, as well as conducting front rank research in cosmology, active galaxies, Galactic Structure, and star and planet formation, operates the Cambridge Astronomy Survey Unit (CASU) which develops major science pipelines which are used to generate the science data products for major missions such as the European Southern Observatory's VISTA infrared survey telescope (which will generate data at the rate of >100TB/year). Additionally it processes the data from the VLT Survey Telescope, the Isaac Newton Group of Telescopes (in particular the Wide Field Camera). The Institute of Astronomy leads the Photometric processing in the Gaia Data Processing Consortium, and will be responsible for one of the main Data Processing Centres for Gaia, ESA's cornerstone astronomy mission for launch in 2011. The Institute of Astronomy is a member of the Planck Data Processing Consortium.
As well as this astronomical expertise, Cambridge is world renowned for both theoretical and applied computer science, the Computer Lab and the Cambridge eScience Centre being two centres of activity. It hosts the High Performance Compute Facility – the current Darwin machine being the most powerful civilian supercomputer in the UK. AstroGrid and CASU both collaborate actively with this local pool of expertise in Grid and e-Science activities.
The Institute of Astronomy, the Computer Laboratory and e-Science centre are located within the University of Cambridge, West Cambridge Campus. The Campus also hosts the European Microsoft Research Laboratory

Key staff at the IoA, Cambridge include Richard McMahon, Nicholas Walton and Guy Rixon. **McMahon** is Reader in Astronomy, lead investigator of the Cambridge AstroGrid involvement, lead investigator of the DAZZLE instrument constructed for the ESO VLT, and one of the most highly cited research astronomers in Europe, with research focusing on the study of the high red-shift universe. **Walton** is AstroGrid Project Scientist and secretary of the IVOA. He is co-Chair of the Open Grid Forum's astronomical applications Research Group. He has played a major role in the definition and development of the international Virtual Observatory. **Rixon** is the system architect of AstroGrid. He is Chair of the International Virtual Observatory Alliance working group on Grid and Web Services. In this role he had led and developed the VO systems in interfacing to the Grid and Web services realm. He has played a major role in the development of the authentication and authorisation framework for the VO, and the VOSpace storeage system. Rixon is an acknowledged leader in grid and web service technologies.

2.2.6 CNRS

The Centre National de la Recherche Scientifique is the largest public multidisciplinary research organisation in France. For this particular project CNRS will concern researchers/engineers from 6 UMR and 2 UMS geographically distributed in five astronomical observatories: Grenoble, Lyon, Marseille, Paris and Strasbourg. LERMA

(UMR 8112), LUTH (UMR 8102), SIO (UMS 2201) belong to the Observatory of Paris which is a top astronomical institution in France in terms of staff and budget size with activities covering all major research topics in astronomy and astrophysics. It is strongly involved in Virtual Observatory activities and numerical simulations having 2 nodes of the HORIZON project and hosting many theoretical teams. Its computer center (UMS 2201) will offer an entry point to EGEE. CRAL (UMR 5574) has experience in high performance simulation and Virtual Observatory. It hosts one the node of the HORIZON cosmological project. It also participates in regional collaboration with LAOG and local IT laboratories to adapt astrophysical simulation software to Grid architecture. CDS (UMR 7550) references databases and data access tools are widely used by the astronomical community. CDS is also active in R&D projects, and has led in particular the “Massive Data in Astronomy” (MDA) project in the IT ACI “Massive Data”. One aspect of MDA was to study a “light” workflow management tool, with an application to astronomical image processing. The Observatory of Grenoble is a multidisciplinary federation of 8 laboratories in Universe Sciences ranging from geophysics to planetology and astrophysics. LAOG (UMR 5571) has experience in high performance simulation and Virtual Observatory, and participates in regional collaboration with CRAL and local IT laboratories. SCCI (UMS 832) develops local HPC computing facilities as a part of the local HPC network and grid, and participates in regional collaboration with local IT laboratories to develop rugged middleware for the deployment of multi-parametric applications on an heterogeneous grid at regional (CIRA) and national (Grid’5000) level. LAM (UMR6110) belongs to Marseille Observatory, they had many successive GRAPE systems in Marseille and still run the 6 GRAPE5 boards (for the low accuracy), the GRAPE6 and a 4-microGRAPE6 cluster (for the high precision calculations). CNRS will participate to WP5, WP7, WP8 and more strongly to WP10.

Key Persons

M.L. Dubernet (UMR 8112) *Astronomer, scientific leader of Virtual Observatory activities at Paris Obs., activities ranging from VObs output of databases, numerical simulations and software developement, molecular physicist in collisional processes, member of the scientific councils of the French Virtual Observatory and of the National Program “Physics and Chemistry of the Interstellar Medium”, deputy coordinator of the FP6-RTN network “Molecular Universe”.* F. Combes (UMR 8112) *Astronomer, working in galaxies and cosmology. co-PI of the project HORIZON, a numerical simulations project which has the goal to study galaxy formation in a cosmological context, involved in the SKA-Design-Study process, president of the National Galaxy Program for INSU and Chair of Theory, Computers & VO Road-map Panel in the European Astronet network. Benoit Semelin (UMR 8112) Associate Professor in Paris 6 University, co-I of the project HORIZON, involves in SKA-Design Study numerical simulations, teaches parallel coding. N. Moreau (UMR 8112) Research Engineer, software design J.-M. ALIMI (UMR 8012) Director of Research in CNRS, Director of the LUTH, Co-PI of the project HORIZON.* F. Le Petit (UMR 8102) *Associate Astronomer, project leader of the Simulation Data center of Obs. Paris, member of the VObs-Theory interest group, modelisation of non-equilibrium physics and chemistry of neutral interstellar medium.* F. Roy (UMR 8102) *Research Engineer, parallel computing.* A. Shih (UMS 2201) *Research Engineer, main IT engineer for the Computing infrastructure of the VOrg in Paris, will interact with EGEE group.* J. Marchand (UMS 2201) *Applied mathematics and IT engineer, director of the central IT, in which 18 people work. This team is in charge of all common IT tools.* P. Le Sidaner (UMS 2201) *Research Engineer, project manager for VOrg at the Obs. Paris.*

H. Wozniak (UMR 5574) *Associate Astronomer, leading Virtual Observatory WP of the HORIZON project, Vice-Chair of the Theory Interest Group of the IVOA and member of Theory Expert Group of Euro-VO DCA, member of the Scientific Council of the French Virtual Observatory, expertise in non-linear dynamical modelling and self-consistent chemodynamical simulations of galaxies.*

A. Schaff (UMR 7550) *Research Engineer (CNRS) at CDS, works on the VOTech project, leads the Architecture Design Study at the CDS level, CDS contact for the WP5 (Relation with the Grid) of the EuroVO-DCA project.5Also included at UMR 7550, M. Louys and F. Bonnarel.*

P. Valiron (UMR 5571) *Director of Research, specialist in molecular astrophysics, involved in the “Molecular Universe” FP6 project, pioneered Monte Carlo explorations of the multidimensional interaction*

space between molecules and validated the local grid middleware, member of the Scientific Council of the French Virtual Observatory, presently chairman of the specialized committee for Astronomy and Astrophysics of the National Institute for Universe Sciences (INSU) of the CNRS. F. Roch (UMS 832) *Research Engineer (CNRS), key person in development of the local grid "CiGri", participates to the middleware developments for combining conventional operation of the cluster with local grid production and national Grid'5000 experiments.* B. Bzeznik (Université Joseph Fourier) *Research Engineer on the CIMENT project, gridmaster of the local grid CiGri , contributor to the administration of the national IT grid Grid'5000 and co-developer of the grid tools OARGRID and CiGri.* A. Faure (UMR 5571) *Researcher, modelling of molecular collisions, extensive user of the local grid middleware. member of the scientific committee for Universe Sciences at the national computers IDRIS, CINES.* F. Berthoud (UMR 5493) *Research Engineer, IR2, in charge of clusters for physics and biology, and of their integration into the grid CiGri.* F. Ménard (UMR5571) *Director of Research, chairman of the Scientific Committee of the National Program of Stellar Physics.*
E. Athanassoula, (UMR 6110) *Astronomer, Galactic dynamics and N-body simulations, Important expertise with GRAPE systems and PI of the GRAPE3, GRAPE4, GRAPE5 and GRAPE6 projects in Marseille.*

2.2.7 CSIC

The Consejo Superior de Investigaciones Científicas (CSIC) is the largest public multi-disciplinary research organisation in Spain. It has a staff of more than 10000 employees, among these 3202 scientists and about 3802 pre and postdoctoral researchers. The CSIC has 116 Institutes or centres distributed throughout Spain. There is also a delegation in Brussels. It has considerable experience in both participating and managing R&D projects and training grants. Under the 6th F[ra]mework Programme, the CSIC has signed 418 contracts (37 coordinated by the CSIC). The CSIC is the 5th o[rg]anisation in Europe in project execution. Its portfolio covers a wide spectrum of interests, ranging from biology, chemistry or physics, to social sciences.

The Instituto de Fisica de Cantabria, IFCA, placed in Santander, in the north of Spain, is a joint center CSIC-University of Cantabria, with research lines in Astrophysics, Particle Physics and Statistical Physics. The Cosmic Microwave Background (CMB) group at IFCA, lead by Prof. E. Martinez, participates in the ESA Planck mission, and the Distributed Computing (Grids) group, lead by Prof. J. Marco has successfully participated in several e-Infrastructure projects (CrossGrid, EGEE) and coordinates the Interactive European Grid project. Computing resources at IFCA include several clusters and storage systems (>400 cpus and >100 Tb on-line), and IFCA also hosts the node of the Spanish Supercomputing Network at Universidad de Cantabria (a high performance cluster with 512 processors, included in latest top500).

Key Personnel
Dr. **Enrique Martinez-Gonzalez** - CS–C research professor at IFCA, responsible for the Cosmic Microwave Background (CMB) and Large Scale Structure research line. PhD in Astrophysics in 1986, he has published more than 100 papers in refereed journals in the field of astrophysics, 90 publications of proceedings of international workshops and has supervised 5 doctoral theses. He was the coordinator of the first European network on the Cosmic Microwave Background and is the coordinator of a project to build the Back-end modules of two frequency channels to fly on board of the Planck mission of ESA. He is Co-I of the Low Frequency Instrument consortium of the Planck mission and one of the proposers of the Bpol mission to the ESA Cosmic Vision.
Dr. **Jose M. Diego** - "R–m"n y Cajal contract" at"IFCA. PhD in astrophysics in 2000, postdoc at University of Oxford, University of Pennsylvania, and MIT, working on several research

topics in astrophysics and cosmology. He coordinates a national research project and a bilateral project with the University of Kwazulu-Natal (Durban, South Africa) for the use of the SALT telescope to prepare the scientific exploitation of Planck mission data. He has 24 publications in international peer reviewed journals, 7 proceedings and 13 oral presentations at international conferences.

Dr. **Isabel Campos Plasencia** - I3– postdoc of CSIC at IFCA. PhD in Latttice QCD in 1998 at the University of Zaragoza (Spain), postdoc at DESY and Brookhaven labs. She worked at the LRZ center in Munich for two years in the development of Linux Cluster. She then joined BIFI in Spain, where she set up the new computing center and integrated it in the EGEE infrastructure. In 2006 she moved to IFCA, where she leads the integration of applications in a grid framework in several EU projects.

Prof. Jesus Marco (IFCA director, responsible for the Grid&e-Science research line at IFCA), **Dr. Belen Barreiro**, and **Dr. Patricio Vielva**, will also participate in AGENA.

2.3 Consortium as a whole

The partners forming the Consortium submitting the AGENA proposal are institutions covering research activity in astronomy, astrophysics and cosmology in five European countries (Italy, Germany, UK, France, Spain) and an International Organisation (ESA), all of them important in terms of involvement in major projects in this scientific domain. The partnership is complemented by INFN, which has some vested interest in high-energy astrophysics experiments, but in the context of AGENA it participates mainly as a developer of Grid middleware, being a key partner of the EGEE projects and recognised leader in the field.

Within each country or organisation, the partner institution represents a number of associated sites, either for the institution’s distributed nature (INAF, INFN, ESA, CNRS, CSIC) or because the partner represents a national consortium (AIP on behalf of Astrogrid-D, UCAM on behalf of AstroGrid).

The above consideration allows to define the Consortium as guaranteeing an important coverage in terms of project participants and, complementarily, ensures the possibility of reaching a wide scientific community external to the project proper. This characteristic has an important impact on properly disseminating the results of the project to potential users and encourage the exploitation of the available facilities.

Some of the participants in the Consortium are known for their competence and experience in designing, building and maintaining complex and advanced systems for capacity computing and data management (INFN, UCAM, AIP, CNRS, INAF). The EGEE e-infrastructure, national Grid infrastructures, archives of astronomical data interoperable through the Virtual Observatory facilities, and the VObs added-value tools and services, are just some examples. An additional item is in particular to be noted, i.e. the specific commitment of partners to provide high-level and sustainable services to the community of users.

There is specific knowledge in the development, upgrade and maintenance of Grid middleware and tools (INFN, AIP) which guarantees the capability of understanding the internals of the e-infrastructure and intervening at its lowest levels. The experience INFN has gathered as EGEE partner with specific leading responsibilities in the domain of middleware development, can ensure that proper coordination with the relevant development teams in EGEE is maintained, and the AGENA enhancements are kept in synch and harmonised with EGEE’s mainstream developments for the benefit of the whole community of Grid users.

On the other hand, and most importantly, the partner institutions are well known for their scientific excellence in the fields of astronomy, astrophysics and cosmology. Leading scientists participate directly in AGENA, mainly for the porting on the Grid of advanced and computationally demanding applications related to data processing and analysis (ESA, AIP, INAF), and to numerical simulation of astrophysical phenomena or instrument behaviour (CNRS, CSIC, AIP).

There is among scientists an increasing need for computing capabilities, triggered by the data avalanche astronomy is experiencing in these very years, and by the need to understand the observed phenomena by means of theories needing underlying numerical models of increasing complexity. The community is therefore seeking for computing facilities growing in power with a pace which is at least an order of magnitude faster than Moore's law. This can only be achieved by HPC, where needed, or by shared resources. There is therefore in the scientists belonging to the Consortium the highest motivation for the implementation and testing of their applications on the Grid infrastructure. For some of them there is also a high level of Grid user expertise.

The partner institutions are also deeply involved in development projects aimed at the implementation of large and leading-edge instrumental facilities, either ground-based or space-borne. Direct participation in projects like LOFAR, SKA, LBT on one side and Herschel and Planck on the other, make partners well aware of what the data challenge is, and of the e-infrastructures needed to cope with it. The requirements on the Grid set by the large instrumental projects can therefore be well understood and covered by the AGENA partners.

All of the partners run in their local sites clusters of varying computational power. A considerable fraction of these systems will be made available through AGENA to EGEE, enhancing to a certain extent its potential.

Complementarity is one of the key aspects of the AGENA Consortium. The WPs have been structured to maximise collaboration by limiting the amount of overlap in knowledge, with the purpose of avoiding duplication of efforts or, worse, competition between partners.

In principle, all partners will be taking part in Strategy choices and internal Coordination (WP2) and will give their contribution to external Dissemination (WP3) by complementing the WP leader's outreach and international coordination activity through participation in international events (conferences, symposia) to spread information about AGENA's activities and results, and to promote the use of Grid facilities and the adoption of its standards.

There is a first point of complementarity in the knowledge of Grid middleware: INFN has a long track of development experience from the initial pilot projects (INFNGrid, DataGrid), to the various stages development of EGEE development in terms of middleware, from LCG to gLite. Complementarily, AIP (and Astrogrid-D in general) has specific knowledge on Globus (GT4 in particular), but is specifically committed in the operation of helping the integration of tools and services within EGEE, helping and contributing to its anticipated evolution.

This complementary knowledge on middleware internals reflects directly in the Training activity (WP4), which will be carried out by a composite group composed of INFN and AIP, with the support of INAF. The latter group has specific experience in supporting astronomers in porting their code on the Grid, gathered through national projects, the Planck Virtual Organisation, the VO-DCA Grid-VObs coordination activity, and within the EGEE NA4 work-package.

The knowledge available at the above mentioned institutions, coupled with the specific experience UCAM (and AstroGrid in general) has gathered in the development of the Virtual Observatory standards, infrastructure and tools (with support from CNRS and INAF groups), make the Middleware Upgrade team (WP7) very well balanced.

UCAM leads the Grid-VObs Interoperability team (WP8), which is conversely composed of partners having specific VObs knowledge (UCAM, CNRS, ESA, INAF), but also specific knowledge of Grid middleware (UCAM, INAF).

The JRAs aiming at the porting of complex applications onto the Grid (WP9 and WP10) are driven by specific scientific interests which are complementary by definition. It is to be noted that, if for the numerical simulations (computation driven) the Grid facilities probably offer already proper solutions, the data processing applications (data driven, by definition) may be imposing a higher number of new requirements on middleware developers, and hence a larger amount of work on WP7.

In Service Activities, there is a total subdivision among partners between Support to the Astronomical VObs (WP5) carried out by AIP, CNRS, ESA, CSIC, and Support to the Porting of Application (WP6) where INFN, INAF and UCAM will work.

A key role to allow complementarity to become an asset of the project and not a dispersion factor, will be played by the coordination bodies of AGENA. In particular, it will be within the Executive Technical Team that the various approaches and diversities will be harmonised to produce a unified and manageable set of project results.

As mentioned in the introductory sections of the proposal, AGENA will be open to discuss and incorporate external contributions and, conversely, to support scientists in non-partner institutions (also from other countries, with special reference to new member states or candidate countries) to port their code on the Grid. This is expected from one side to allow widening the user community, and on the other to bring new (possibly complementary) experience to the project.

2.4 Resources to be committed

The resources the AGENA partners commit to provide to the project are basically contributed person-power and computational resources to be included in the Grid infrastructure.

Partner staff contributed to the project, and for which reimbursement will not be requested to the EU, is clearly indicated in Table 1.1b, in section 1.1.3. The total amount of contributed staff (permanent personnel, or hired on non-EU funds) is estimated to be 247 person-months (for the partner having left unspecified the balance between contributed and supported staffing, the contributed staff has been considered to be ½ of the total). .

This amount of more experienced person-power will be essential to steer, coordinate and advise the project within the relevant guidance bodies (Board, Executive Technical Team, Science Advisory Committee). Contributed staff is also necessary to introduce the newly-hired staff to the project, to provide them guidance, to produce specific parts of the work, to organise and support training events, to disseminate results and methods internally and externally.

These human resources are taken explicitly into account within each work-package, and are therefore integrated fully within the project planning. There is specific commitment by the partners to provide this staff, at the point that most of this personnel is already identified nominally in the proposal; the remaining will be identified specifically during the negotiation phase.

As for computational resources, partners commit to contribute dedicated or shared CPUs to EGEE. In particular, the following resources are fully EGEE compliant and already available for production work:
(a) The INAF sites of OATs and OACt (the latter shared with INFN) are already operational nodes of EGEE, supporting production work. OATs currently contributes 48 cores, which are expected to be raised to about 200 when the new computational cluster is installed at the end of Q2 2007. OACt is developing jointly with INFN-Catania an HPC-oriented campus Grid system consisting of over 1500 cores, part of which will be made available.
(b) ESA has recently installed and made available to EGEE a limited number of cores (12) at its ESAC location, to complement its dedicate campus grid and as the seed for a growing computing resources to be shared through EGEE.
(c) CSIC has in its IFCA location at the University of Santander a consistent number of cores available to EGEE and to the int.eu.grid project. Part of these can be shared within AGENA.

Additionally:
(d) Paris Observatory is an independent entity managing its own hardware. Currently it operates a small cluster of 48 cores. The whole Computing Department (UMS 2201) is being currently updated with an internet connection of 1Gbit and a modern flexible storage system. Computing facilities are in the process of being upgraded. By the start of the EU project, Paris Observatory will operate a medium scale cluster between 100 and 200 cores that will be partially coupled to EGEE (with expected increase of power in the following year).
(e) Nodes in AstroGrid and Astrogrid-D running Scientific Linux are expected to be coupled to EGEE as a result of AGENA development activities in WP7 and WP8.

Furthermore, in the case of success of development work to be carried out within WP7, other hardware having a different structure or running different types of operating systems may be attached to EGEE. In particular:
(f) Clusters in Grenoble are regrouped within the CIMENT initiative https://ciment.ujf-grenoble.fr/. In particular, the Observatory of Grenoble (UMS 832) operates a Solaris 10 cluster with 30 quadriprocessor nodes (120 procs) which is complemented by 12 nodes connected to the French grid initiative Grid5000. These resources are also part of the above mentioned regional grid CiGri which will be extended to Lyon within the CIRA regional and state action contract for the next seven years. This infrastructure will be partially coupled to EGEE according to the progress in the middleware evolutions described in WP7.
(g) The special purpose GRAPE hardware was first being employed by's ZAH/AstroGrid-D together with OAMP/CNRS; recently advanced hardware concepts such as using reconfigurable chips (FPGA) have been introduced, for which software is currently being developed. The GRAPE cluster hardware available at ZAH and OAMP may be experimentally integrated the into the EGEE grid environment according to the progress in the middleware evolutions described in WP7.

These partner contributions, together with the ones for which the EU support is requested, will form the complement of human and hardware resources that are needed to successfully perform the project. They will be integrated into a coherent plan, as discussed above in this and previous sections, by the management structure and governing bodies of AGENA.

The partner contributions and the EU financial support are expected to be sufficient for reaching the objectives of the project. The risks of having more support requests than foreseen and of having set too ambitious research activities (risks SA-R1 and JRA-R1 in the Risk Register, respectively) are planned to be mitigated with appropriate actions (prioritisation and search for external resources. Only if the mitigation actions fail, then AGENA's goals might not be reached completely.

Section 3. Impact

3.1 Collaborative arrangements and perspectives for their long-term sustainability

3.1.1 Expected Structuring effect

There is an increasing awareness among scientists in the astronomical community, and within funding bodies, of the need to maximize the scientific return on the significant investments already made for the construction of telescopes and instruments, and on those which have been planned to create the new generation of observing facilities. While these investments are domain-specific, those made for the creation and support of computing infrastructure can be considered to be general-purpose and re-usable by many different scientific domains. To optimise the investments in computing, it is therefore necessary to achieve a structuring effect and allow long-term sustainability to the e-infrastructures accessible to astronomers.

One of the paths to follow is to foster active participation in Grid initiatives: in this way, the astronomical user community will be able to tailor and further deploy services for its specific domain of research, exploiting the relevant available layers of this e-Infrastructure, from the low levels of networking (NRENs and GÉANT) up to the grid middleware (e.g. gLite) and data.

The evolution of technology in the field of computing show a trend for the establishment of local, metropolitan and national grid infrastructures, relying on a similar, if not the same, set of middleware items. Within these initiatives, it is natural to foresee the creation, at the appropriate level, of astronomical Virtual Organisations aimed at supporting astronomical research. All of these initiative should be appropriately coordinated, so to allow leveraging on local and national resources in a more effective way to achieve broader European benefit.

AGENA is expected to have a strong structuring effect on the community as a whole, offering information and support on the gridification of astronomy applications with their peculiar requirements, thus allowing scientists a more efficient way to obtain results which will ultimately be shared by the astronomy community in Europe, and beyond by the world-wide astronomy community.

AGENA will organise the coordination, at the European level, of the astronomy groups involved in national and European Agencies Grid initiatives on the integration of their resources and enabling of their applications on the Grid. AGENA will create a forum that will facilitate the take-up of Grid standards, share best practice for data providers, consolidate operational requirements for astronomical applications, and enable the identification and promotion of requirements from programs of strategic national interest that require capacity computing technologies and services. National priorities will be discussed, and collaborations and synergies between partners will be sought. AGENA thus brings ‘European added-value’ on top of the individual Grid-related projects in astronomy, represented by the partners. It will also work to increase the awareness on the Grid capabilities within the astronomical communities from other European countries, since the networking activities will be widely publicized and open to participants from beyond the partner countries, especially from new European and candidate countries.

3.1.2 Relations with other initiatives

The main initiative the AGENA project will interact with is EGEE, since it proposes the exploitation of the Grid infrastructure by a new community of users. The project is tightly coupled with EGEE-II (funded by EU/FP6), and should be considered to be an EGEE-II related Grid project. The project plans to develop some enhancements in the capabilities of the Grid infrastructure: to fulfil new requirements coming from the astronomical community, middleware upgrades are planned to be implemented, in full coordination with EGEE through the partners participating in EGEE-II. Such upgrades will be contributed to EGEE and are expected to be usable by all Grid users. The participants plan to build one or more Virtual Organisations, and to contribute CPUs to the EGEE infrastructure. Conversely, they plan to use the standard services provided by EGEE (including computing facilities and available products) to run their applications. In some cases, EGEE middleware and products may be required to run on local, campus or metropolitan grids for tasks requiring high bandwidth connections among processing nodes.

Quite reasonably, the AGENA partners interact with and depend on their own National Grid Initiatives. On the other hand, the coordination of the NGIs within EGI, the European Grid Initiative, will ensure that there will be no contrasts in the development policies, just as the National Research Networks (NRENs) have been able to harmonise within GÉANT.

AGENA will interact and coordinate as well with the European Virtual Observatory (Euro-VO), and in particular with the EU/FP6 funded projects VO-Tech and VO-DCA. For what concerns the implementation of interoperability mechanisms between the Grid and the Virtual Observatory, this activity derives directly from the WP in VO-DCA dealing with coordination between the VObs and the computational grid communities, and liaises with the WP in VO-Tech implementing prototype tools for the VObs infrastructure. On the other hand, the porting of numerical simulations to the Grid has a direct impact on the VO-DCA WP dealing with the provision of theory data and services in the Virtual Observatory; similarly, the porting of data processing applications to the Grid will positively interact with the VO-Tech WP dealing with the provision of tools for the VObs.

On the other hand, AGENA is already coordinated with the EuroVO-AIDA proposal, submitted as a response the FP-INFRASTRUCTURES-2007-1 call, under INFRA-2007-1.2.1 (Scientific Digital Repositories). The proposals have been cross-checked to ensure they are absolutely complementary; there are no overlaps between the proposals, but several points where coordination will be enforced.

The project is planning to coordinate with major infrastructure projects for astronomy, such as the Square Kilometre Array (SKA) and the Extremely Large Telescope (ELT), identified by ESFRI as top priority for astrophysics. Porting on the Grid infrastructure the SKA simulations and/or processing code for radio-astronomy data (fundamental for the reduction and analysis of SKA data) is already part of the AGENA proposal; coordination between the two projects will be pursued to allow cross-fertilisation (discussion of requirements, dissemination of results, spread of best practice, etc.). As for the relations with ELT, AGENA coordinates with the EVALSO project, submitted as a response the FP-INFRASTRUCTURES-2007-1 call, under INFRA-2007-1.2.2, with the purpose of creating a high-throughput network infrastructure between the European and South-American sites of the European Southern Observatory (ESO) with the purpose of supporting transfer and processing of the huge data sets which will be produced by ELT.

3.1.3 Sustainability

As mentioned above, it is well understood that high-level research is increasingly complex, interdisciplinary and costly and requires a constantly increasing critical mass of resources. This project responds to these challenges by creating the awareness within the astronomical community that the sharing resources within a unified Grid infrastructure for Europe is the path to follow to solve the needs for scientific capacity computing, in a way that few individual organisations or even nations can do.

Astronomical organisations, by providing computational resources by to the generalised pan-European Grid e-infrastructure, will contribute to its long-term sustainability. Furthermore, by participating (passively as user, actively as resources provider) at this time in the European Grid e-infrastructure, the astronomical community reinforces the usefulness and benefits of the European investments in Grid technology to date, especially in terms of expertise and human capital that has been generated in the European EGEE project and related EU Grid projects.

The current lead position Europe holds as an integrator of Grid technologies and as a Grid infrastructure provider will have a positive impact on the scientific output of the European astronomical community, further enhancing its international role.

It is also to be noted that the project, by creating awareness within the astronomical community, will encourage its participation in the definition and coordination of policies on Grid computing at the national, regional and European levels, which will ensure the long-term sustainability of the established infrastructure, and facilitate its extension.

3.2 Expected impacts from Access and/or Service activities

The goals of the Service Activities can be summarised as follows:

- Coordinating groups who are active in astronomical research and have already implemented the Grid paradigm for their computational needs.
- Providing Grid access to a large community of scientists which up to now has been involved only partially in deploying its applications on the Grid.
- Liaising with a number of projects in Europe related to astronomy, astrophysics and cosmology, to support their capacity computing needs through the use of the Grid.
- Providing continuous feedback to Grid developers (particularly within EGEE), in order to allow new requirements coming from the astronomical community to be taken into account when upgrading middleware.

The achievement of the objectives mentioned above is expected to bring several benefits to astronomers and for the community at large. Such benefits are mentioned in the following.

There is a good number of high-level scientists participating in AGENA. At the end of the project, institutions and scientists known for the excellence of their scientific work will have ported their applications to the Grid, and their codes will be running in production mode on the Grid infrastructure. Being such codes used for research programmes at the leading edge of astrophysics, important results are expected to be achieved, and they will be beneficial for the development of science.

There is a large community of potential new Grid users in the astronomical domain. It is especially at general conferences and symposia for non-specialists in scientific computing that astronomers should be exposed to the capabilities of the Grid. Through the foreseen dissemination activity the knowledge about the use of the Grid for astronomy, gathered by coordinated experience in this project, will be spread to this wide audience. Consequently, thousands of astronomers throughout Europe will be in a position to take advantage of the capacity computing provided by the Grid.

Several major instrument development projects in the astrophysical domain will be in the position to use AGENA's experience and structuring effect to expand their processing capabilities by using the Grid infrastructure. The enhanced throughput in the production of scientific results will be beneficial for the whole community.

The requirements from the AGENA integration teams to the middleware developers (both within and outside the project) are expected to produce middleware upgrades and tools allowing the solution of problems currently impossible, or awkward, to solve within the Grid. The resulting enhancements in the capabilities of the Grid infrastructure, obtained through middleware such upgrades, will be usable by, and beneficial for, all EGEE users.

3.3 Expected impacts from Joint Research Activities

Within the EGEE project, the need to integrate domain specific research areas has been recognised. The key activities of this JRA will focus on carrying out the vital astronomy domain specific research necessary to meet the goal of providing a seamless interface to the heterogeneous range of European level computational and storage resources exposed via the EGEE middleware.

The research is structured into four key areas: where JRA1 will extend the EGEE middleware such that it is usable in a more pervasive manner to the European astronomy community; JRA2 which will focus on providing the key linkages between the established global international virtual observatory data services and the computational grids; JRA3 will make astronomy domain legacy and emerging application environments, which are currently commonly used on the desktop, accessible on distributed grids; JRA4 will provide the specific interfaces to the most computationally demanding simulation applications.

A European level of research activity is essential to leverage the clusters of national activities currently underway in this area. Additionally it will build upon the links developed by European groups in current and previous activities such as standards work carried out in the IVOA, the integration of applications of value to the gravitational wave community through the EU FP5 GridLab project and so forth. European activity, where key groups are involved, ensures interoperability of the systems to national research groups. AGENA is aligned to support astronomical research in Europe which is already largely structured at a European level (exploiting EU and European investment into community activities such as the space programme of ESA and the world class telescope facilities of ESO, shared computational infrastructures such as that provided through DEISA and so forth).

AGENA is constituted from the major groups in Europe with exisiting expertise in the area of grid and astronomical computing. Through the activities of the networking area, research from the JRAs will be communicated to the relevant external national and project groups, for instance projects such as the SKA consortium who will benefit from AGENA access mechanisms to EGEE computational resources.

EGEE provides a powerful framework making available powerful computational facilities to a wide range of domain specific users groups. Within EGEE II, the applications network activity NA4 has worked with a number of external user groups, including projects from the Astronomy community, e.g. the PlanckGrid activities. This work has demonstrated the power of interfacing through EGEE middleware. However, useful lessons have been learnt, where current gaps in the usability of the system have been identified. For simple compute intensive jobs, EGEE provides current capability. Expanding this to support the more sophisticated data and workflow problems more commonly found in Astronomy is the challenge that will be met by JRA1. The benefits from the extension of the middleware will be significant and will underpin the service and networking activities of AGENA.

The Virtual Observatory (VObs) has developed a sophisticated data discovery and analysis framework which provides pervasive access to the widest range of European and Global astronomical data. The FP6 VO-Tech project, led by AstroGrid, is developing the design study and test implementations which will lead to the deployment of a VObs infrastructure across Europe. The testbed infrastructure has been deployed by AstroGrid in the UK, and is now moving to operational deployment to support the UK astronomy community.

To the UK astronomer, utilisation of the AstroGrid system provides full access to global data resources (e.g. USA data such as, Chandra, SDSS, VLA; European data such as that from ESO, ESA) which, when coupled with the range of AstroGrid services – fast work-flow, large MySpace staging storage, access to large UK computing provision (e.g. the National Grid Service), access to integrated data mining tools and visualisation capabilities – enables them to carry out more effective astronomical research.

The JRA2 activity here will expand upon this ground breaking work in the UK, to better integrate this VObs infrastructure with the European wide grid computational frameworks such as EGEE. This will mean that the complex astronomy work-flows will have access to a larger pool of generic compute resources. Conversely, users of the EGEE compute infrastructure, where the ability to generate rich work-flows is limited, will gain by utilisation of VObs techniques and systems.

JRA2 will work with use cases from the VObs community – as prioritised by the Euro-VO Science Advisory Committee – to inform the scope of the interfaces required between VObs and Grid. Example cases of initial work can be found in the Science Reference Framework document of the VO-Tech project[50]. In particular cases such as those exploring large scale galaxy structure, will benefit from increased computational capability as offered by EGEE, with the VObs being used to define the work-flow and give access to the global heterogeneous data sets.

Routine operational availability of major project-specific astronomical data reduction packages on the Grid will demonstrate to the astronomical community that the computational Grid is the appropriate paradigm to run standard astronomical data reduction packages. Data centres in Europe will be encouraged to use the Grid to run similar activities as they will see the substantial benefits of doing so. By joining the new astronomical VOrg, Data Centres will bring more resources into the EGEE. Additionally, the EGEE Grid will be extensively used to process astronomical data through this routine project data reduction, demonstrating the usefulness of such Grid infrastructure in Europe.

The research work to be carried out within JRA3 will develop the key research that will be require to integrate major data reduction packages into the grid. JRA3 will ensure that an adaptable and scalable set of interfaces are developed, perhaps building on the Uniform Worker Service interoperability standard being developed within the framework of the IVOA Grid and Web Services Working Group. This will ensure that with the inclusion of more European data centres into the astronomical VOrg, it will be possible to make their widening range of astronomical data reduction packages, this in turn making the system of use to a wider range of science users, reflecting the wider provision of applications.

By bringing solutions and demonstrating use cases to the challenges of transportation of data within the Grid nodes, transportation and deployment of astronomical software onto the Grid nodes and priority and security requirements, data centres will feel more convinced that the Grid can be used for their routine tasks, increasing the number of participants of the astronomical VOrg and increasing the usage of the EGEE infrastructure overall.

[50]http://wiki.eurovotech.org/twiki/pub/VOTech/VotcSFD/sfd-v0.6.pdf

By having access to more computational resources, data centres will be able to serve better their scientific communities by speeding up the time to deliver scientific products, both in the context of on-the-fly and bulk reprocessing. By having faster access to the best scientific products, the scientific outputs of the projects will be increased. Furthermore, scientists will feel more confident in adopting this new Grid paradigm for their daily scientific data reduction activities as it will be used routinely for a major astronomical project. By having gained this experience, making grid-enabled other astronomical data reduction packages will also be made easier and therefore will encourage software developers to do the same. JRA3 will provide the key research in enabling this work.

Running numerical simulations provide a high end driver, where major computational resources are required to make the major science breakthroughs. Simulations from the range of different areas of astrophysics on the Grid will produce a set of “good practices” that will be shared trans-nationally through reports and updates of middleware. Detailed benchmarking of the deployment and throughput of the simulations will provide some insight into the efficiency of their “gridification”, and will be a matter of discussion and cross-fertilization among the different groups across WPs.

The JRA4 will prove to external collaborators the usefulness of Grid technology at the European level and encourage through the gained experience new users to join the EGEE grid. Indeed the European dimension of the project is very important in order to convince new users to port their code on the Grid; the porting of numerical simulations must be seen as a real improvement for the outcome of their research. And only a European collaboration of teams from different fields can be convincing enough in order to encourage new users.

The JRA4 will have a significant impact on training of young researchers and engineers through their involvement in research activities carried out in the collaborative teams of the network.

3.4 Dissemination and/or exploitation of project results, and management of intellectual property

Dissemination activities will take place at a number of levels to ensure that the major stakeholders associated with AGENA are fully engaged. Dissemination will occur, to some extent, across all AGENA work-packages, but the main focus will be concentrated in the Networking Work Packages.

Exploitation of project results and management of knowledge will be handled both at national level by the different structures implemented in the partner's countries, and at international level through the international outreach of some of the partners.

AGENA activities will be communicated to the community via a variety of methods: the on-line web presence, through meetings with close partners such as EGEE; through conference presentations and publications; through training workshops; and through working participation with projects such as the Euro-VO Technology Centre.

(a) European infrastructure, the technical context.
WP2 will organise much of the flow of information and results between the major technical partners of AGENA. In particular it will participate in a range of technical meetings with EGEE and a lesser extent GEANT and DEISA. The purpose of these will be to update AGENA on the latest strategic development of these key European infrastructure projects, and in turn to feed back the results of AGENA investigations. At the operational level AGENA will be a participant in the EGEE User Forum.

(b) The European technical user community.
A range of training events will be held, organised by WP4. These will focus on informing the technical staff in the astronomy community how to access the capabilities offered by AGENA. In particular the focus will be on major new astronomy projects who wish to exploit the European computational infrastructure to enhance their data analysis and interpretation capacities.

(c) The European astronomy user community.
WP4 will also organise a series of training events aimed at European astronomy end users. These will highlight the new access opportunities available to large scale computational facilities, and how they can run their work-flows on these facilities. These workshops will be hosted at a range of major European institutes to ensure the widest possible 'reach' and materials will be streamed live via the web to further increase participation opportunities.

(d) The wider international community.
AGENA will participate in a range of forums to disseminate and interact with the wider IT and e-Science communities. In the context of standards development it will continue to take part in the Open Grid Forum activities, noting for instance that AGENA collaborators already participate actively in its activity, and in particular lead the OGF Astronomical Applications working group. AGENA will also participate in the IVOA standards activities, and through partner membership of the Euro-VO will ensure the bridge between these communities.

(e) General supporting infrastructure.
AGENA will set up a range of information systems to allow for the dissemination of information both within the project, recognising the distributed nature of this pan-European

collaboration, and to the external world. A main content management system will be hosted by ESA/INAF through the work in WP3. A collaboration wiki site will be a major aid to internal collaboration. A source control system such as subversion will ensure for the availability of the software components developed through the project. Use of online video materials will be used to support the training activities. Project meetings will be held face-to-face, by tele-conference, and increasingly by video-conferencing. Use of Access Grid will support larger distributed project meetings. A mailing list will allow for the announcement of major new facilities and capabilities from AGENA to the community.

(f) Licensing policy.
All software and publications (with the possible exception of some internal project finance and HR material) will be published into the public domain. Use of an Open Source Initiative (OSI) approved license will be adopted. Management of Intellectual Property will be formally defined in the AGENA consortium agreement.

For example in France national structures might involve thematic structures such as "National Scientific Programs" on galaxies (PNG: Programme National Galaxies - http://lerma7.obspm.fr/~png/), physical-chemistry of the interstellar medium (PCMI: http://www.obs.u-bordeaux1.fr/pcmi/), ASSNA (Action Specifique pour la Simulation Numerique en Astrophysique - http://luth.obspm.fr/~luthier/mottez/simulastro/welcome.html) and the French Virtual Observatory (http://www.france-ov.org/) which has the means to organise tutorials on the subject (P. Valiron, H. Wozniak and A. Schaff have already organised meetings). The Observatory of Paris, though its Virtual Observatory section, will organise seminars and tutorials in order to disseminate knowledge and to help new astrophysical users to port their application.

Section 4. Ethical Issues

<u>ETHICAL ISSUES TABLE</u>

	YES	PAGE
Informed Consent		
• Does the proposal involve children?		
• Does the proposal involve patients or persons not able to give consent?		
• Does the proposal involve adult healthy volunteers?		
• Does the proposal involve Human Genetic Material?		
• Does the proposal involve Human biological samples?		
• Does the proposal involve Human data collection?		
Research on Human embryo/foetus		
• Does the proposal involve Human Embryos?		
• Does the proposal involve Human Foetal Tissue / Cells?		
• Does the proposal involve Human Embryonic Stem Cells?		
Privacy		
• Does the proposal involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)		
• Does the proposal involve tracking the location or observation of people?		
Research on Animals		
• Does the proposal involve research on animals?		
• Are those animals transgenic small laboratory animals?		
• Are those animals transgenic farm animals?		
• Are those animals cloned farm animals?		
• Are those animals non-human primates?		
Research Involving Developing Countries		
• Use of local resources (genetic, animal, plant etc)		
• Benefit to local community (capacity building i.e. access to healthcare, education etc)		
Dual Use		
• Research having direct military application		
• Research having the potential for terrorist abuse		
ICT Implants		
• Does the proposal involve clinical trials of ICT implants?		
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

Section 5. Consideration of gender aspects

Within the various partner institutions, in the recruitment efforts– including advertisements – women will be strongly encouraged to apply and the aim will be to achieve equal representation of genders.

In addition, the consortium will undertake positive actions to promote female participation in the IT/astrophysical sciences, through encouraging female applicants to training activities.

Finally, female scientists occupy highly visible and decision making positions within the consortium (e.g. team leader of CNRS and WP10, Executive Technical Team, Science Advisory Board): this will have a very positive influence on the network and will provide natural role models for young female researchers and engineers of the network.

As for the consideration of balance between work and private life, it is to be noted that the growth of home broadband networking and the availability of cheap powerful personal computers enables flexibility of infrastructure access from home, increasing the number of available options. These new facilities enhance the possibility of accessing high class research facilities from home, and this is particularly true for Grid facilities, conceived to allow access to research tools and data irrespective of location.

Appendix A. Acronyms

AEI	Albert Einstein Institute
AGENA	Access to Grids Enables Astonomical research (this project)
AIP	Astrophysical Institute Potsdam
AIPS	Astronomical Image Processing System
APC	AstroParticule et Cosmologie
CA	Certification Authorities
CIC-SL	Consulting Informatico de Cantabria
CiGri	Ciment Grid
CIMENT	Calcul Intensif / Modélisation / Expérimentation Numérique et Technologique
CIT	Centro de Investigación y Tecnología
CMB	Cosmic Microwave Background
CNRS	Centre National de Recherche Scientifique
CPU	Central Processing Unit
CREAM	Computing Resource Execution And Management
CSIC	Consejo Superior de Investigaciones Científicas
DMC	Data Management Component
EGAAP	EGEE Generic Applications Advisory Panel
EGEE	Enabling Grids for E-sciencE
EGI	European Grid Initiative
e-IRG	e-Infrastructure Reflection Group
ELT	Extremely Large Telescope
ESA	European Space Agency
ESAC	ESA Space Astronomy Centre
ESAVO	ESA Virtual Observatory
ESO	European Southern Observatory
ETT	Executive Technical Team
EU/FP6	European Sixth Framework Programme
EUGridPMA	European Policy Management Authority for Grid Authentication in e-Science
EURO-VO	European Virtual Observatory
FTE	Full-Time Equivalent
FPGA	Field-programmable gate array
GAT	Grid Application Toolkit
GAVO	German Astrophysical Virtual Observatory
G-DSE	Grid Data Source Engine
GILDA	Grid INFN Laboratory for Dissemination Activities
gLite	Lightweight Middleware for Grid Computing
GRAPE	Graphics Programming Environment
GRelC	Grid Relational Catalogue
GRID API	GRID Application Program(ming) Interface
GT4	Globus Toolkit Version 4
HPC	High Performance Computing
HUMV	Hospital Universitario Marques de Valdecilla
I3P	Institute for Information Infrastructure Protection
ICT	Information and Communications Technology
IFCA	Instituto de Fisica de Cantabria
IGI	Italian Grid Infrastructure
INAF	Istituto Nazionale di Astrofisica

INFN	Istituto Nazionale di Fisica Nucleare
IRA	Istituto di Radioastronomia
ISO	Infrared Space Observatory
ISW	Integrated Sachs-Wolfe
JRAs	Joint Research Activities
JSDL	Job Submission Description Language
LCG	LHC Computing Grid
LFI	Low Frequency Instrument (of the Planck mission)
LHC	Large Hadron Collider
LOFAR	Low Frequency Array
LPSC	Laboratoire de Physique Subatomique et de Cosmologie
LSS	Large Scale Structure
MCMC	Markov Chain Monte Carlo
MHD	MagnetoHydroDynamic
MPA	Max-Planck-Institut für Astrophysik
MUSE	Multi Unit Spectroscopic Explorer
NA	Networking Activity
NGIs	National Grid Initiatives
NRENs	National Research Networks
OACt	Osservatorio Astrofisico di Catania
OAMP	Observatoire Astronomique de Marseille-Provence
OAR	resource manager (or batch scheduler) for large clusters
OATs	Osservatorio Astronomico di Trieste
OGSA-DAI	Open Grid Service Architecture-Data Access and Integration
OGF	Open Grid Forum
OS	Operating System
OSI	Open Source Initiative
PA	Product Assurance
PEPSI	Potsdam Echelle Polarimetric and Spectroscopic Instrument
PMAS	Potsdam Multi Aperture Spectrophotometer
PMs	Person-Months
PON	Programma Obiettivo Nazionale (funding programme)
ProC	Process Coordinator
QCD	Quantum Chromodynamics
RAVE	Radial Velocity Experiment
RES	Red Española de Supercomputación
SA	Service Activity
SAT	Science Advisory Team
SKA	Square Kilometre Array
SKADS	Square Kilometre Array Design Studies
SME	Small-to-Medium Enterprise
SPARQL	Simple Protocol and RDF Query Language
SPH	Smoothed Particle Hydrodynamics
SRT	Sardinia Radio Telescope
S&T	Scientific and Technological
TBC	To Be Confirmed
UCam	University of Cambridge
USCMS	U.S. Compact Muon Solenoid
VLT	Very Large Telescope
VObs	Virtual Observatory

VOrg	Virtual Organisation
VO-DCA	Virtual Observatory Data Centre Alliance
VOMRS	VOM Registration Service
VOMS	Virtual Organisation Membership Service
VO-Tech	Virtual Observatory Technology development project
W3C	World Wide Web Consortium
WP	Work Package
XMM	X-ray Multi-Mirror Mission
ZAH	Zentrum für Astronomie der Universität Heidelberg
ZIB	Zuse Institute Berlin

Appendix B. Scientific Interest of the numerical simulations (proposed in WP10)

Contribution from partner 3 (AIP)

AIP proposes to grid enable Direct N-body codes (NBODY6++), using special GRAPE/FPGA hardware, for "Modelling Galaxies and Star Clusters" code. The technique, using direct force calculations, is also well applicable to galactic nuclei and protoplanetary (debris) disks. The direct parallel N-Body code NBODY6++ is already one of the use-cases of the Astrogrid-D.
Note: The use and definition of special hardware requires additions to the middleware and scheduler/broker to be able to handle these resources appropriately. This work will be carried out by AIP/ZAH and transferred to UMR6601/CNRS within WP7.

Contribution from partner 6 (CNRS)

The contribution of CNRS to JRA4 involves 6 teams working on different subjects: various themes of the Horizon Project, Modeling of Insterstellar Medium and Astrochemistry.

I. Dynamics and formation of Galaxies in cosmological context (Horizon project, F. Combes, B. Semelin)

I.1 PM + Hydro

In this code, the density of matter associated to each particle is projected on a cartesian grid, with periodic boundaryconditions, by an algorithm of trilinear interpolation. The gravitational potential induced by baryons and dark matter is calculated by solving the Poisson's equation via Fast Fourier Transforms (FFT). The corresponding force is eventually obtained by finite differences, then assigned to each particle by an interpolation algorithm, dual of the previous one. The positions and velocities of particles are updated by using the `` predictor-corrector' ' scheme, a technique of temporal integration at second order, which allows a variable time step. The hydrodynamic part of the code allows the modeling of a perfect gas. The hydro scheme is founded on the technique of Von Neuman and Ritchmyer (treatment of shocks by artificial viscosity), with a diagram of advection of second order in space and an integration scheme of first order in time (explicit). The PM+hydro code is both vectorized at 98 % and paralleled to run on an shared memory architecture with OpenMP.

I.2 PM + Collisions

For isolated systems, the resolution of the gravitational N-body problem is based on the technique of the fast FFT in 3D with the very competitive James's method, with subtraction of periodic images. To study secondary bars, and all phenomena requesting high space resolution in the center of galactic discs, we use a polar grid, with exponential growth in cell radii. For the hydrodynamics, the collisions code with variable masses is optimal for low CPU consumption and its dynamical range (in the ultra dense areas, particles can be thousand times more massive than in diffuse areas). We use the SPH hydrodynamic code, when the gas must be represented by a fluid with pressure forces. All these codes are vectorized and were optimized during previous years for architectures with shared memory.

I.3 Multizoom

We developed a technique of simulation by successive refinements. The simulation starts on large scales (i.e ~ 20 Mpc for the formation of galaxies), then, having stored the force field and matter flows entering a selected region of the field (possibly moving during the simulation), we re-simulate this region by oversampling the zone. By repeating several times this operation it is possible to obtain a very high resolution on a small part of the initial box of the simulation, while calculating the entering flow in a coherent way. By using this technique with an initial box of 20 Mpc and 32 000 particles, we obtain in a zone of 2.5 Mpc a resolution which would require the use of 16 million particles. This gives a mass resolution sufficient to study the formation of galactic discs. It is necessary to remain careful on the fine analysis of the structures in the discs, since a “cut-off” is used for the gravitation at short distance at 2.5 Kpc (usual softening technique). The matter accretion and mergers, which are crucial for the evolution of the morphology of galaxies, can on the other hand be studied in detail (Semelin and Combes 2002, A&A 388, 826, Semelin and Combes, 2005, A&A 441, 55)

II. Dark energy and large scale structure formation (Horizon project: J.M. Alimi)

We have developed numerous numerical codes for studying large scale structure and galaxy formation in cosmology. Presently we are specially interested to study the imprint of the Dark Energy models on structure formation. We have developed essentially two large numerical codes. The first one modelizes the collisionless gravitational dynamics of dark matter using Particle-Mesh N-Body Methods, and the dissipative processes involved in the galaxy formation are modelized using hydrodynamics codes which take into account the out-equilibrium chemical processes in the primordial plasma. This code has been developed using MPI library, it runs with high performances on Grid systems. Recently we have performed very high resolution (1024^3 particles) numerical simulation for studying the structure formation in Quintessence models. A CORBA version adapted for inhomogeneous Grid has been also developed and it is available. A Tree-ASPH (Adaptative Smooth Particle Hydrodynamics) code has also been developed in our team.

III. Galaxies modeling (Horizon project, H. Wozniak)

CRAL will provide an astrophysical simulation code portable to the GRID with full scientific support. The application, already available under an MPI implementation and extensively tested, is based on the so-called Schwarzschild’s technique designed to reconstruct galactic distribution functions. For a given galactic gravitational potential, it computes a huge library of orbits (thousands to millions depending on the spatial resolution). Each computational node receives the galactic model under study and the phase-space initial conditions (one set by orbit/node). Orbital properties (occupation density, Lyapunov exponents, spectral modes, etc.) are sent back to the master for archiving and further local analysis. After gridification, this application can be advantageously used as test-bed for various analyses of GRID efficiency. Feedback from experiments using this application could be valuable for WP10 deliverables.

IV Modelisation of Insterstellar Medium (F. Le Petit)

The Meudon PDR code, modelisation of Photon Dominated Regions, interstellar clouds, circumstellar regions, extragalactic medium, ... Public code used for the interpretation of observations of many instruments (FUSE, HST, VLT, Herschel, ALMA, ...) in the neutral interstellar medium. The code is registered in Astrogrid which allows to run it on clusters of the Observatory of Paris. The next step the developers would like to try is to launch the code on a grid through the VO.

V. Astrochemistry Theme (ML Dubernet, A. Faure, P. Valiron)
The analysis of mm, sub-mm, IR molecular spectra observed in non-LTE media requires the knowledge of precise rate coefficients for the (rotational, ro-vibrational) excitation of the observed molecules by H_2, He or H_2O for cometary atmospheres. Milestones on determination of these quantities were part of the FP6-RTN european network "Molecular Universe" miles. These calculations require to solve coupled differential equation for successive sets of initial parameters, they have been performed using MPI parallelisation on national computing facilities IDRIS, CINES, as well as using "hand made" grid techniques with sequential jobs on the same machines or using local grid at Grenoble. Currently a new astrophysical FP7-ITN network is being proposed where similar calculations are planned for excitation of the internal modes of complex organic molecules.
We propose to port the collisional codes on the EGEE grid and investigate the usefulness of such technology for these astrochemistry applications.

V.I This includes a quantum code from Paris Observatory and
V.II A Monte-Carlo quasi-classical trajectory code from Grenoble. The latter code has been already ported on the Grenoble local grid for intensive production of millions of individual trajectories.

VI. Modeling observations of protoplanetary disks (F. Ménard)
The interpretation of observations of scattered light and thermal emission emitted by protoplanetary disks requires a detailed modelling of 3D radiative transfer on grains. A consistent modelling of data at different spectral ranges, complemented by polarization maps, provides strong constrains on the dust temperature distributions and vertical stratification.
We propose to port on the EGEE grid the continuum 3D radiative transfer code MCFOST, based on a Monte-Carlo method. MCFOST can be used to calculate (i) monochromatic images in scattered light and/or thermal emission; (ii) polarisation maps; (iii) interferometric visibilities; (iv) spectral energy distributions; and (v) dust temperature distributions of protoplanetary disks. MCFOST has been already ported on the Grenoble local grid for intensive production runs.

Contribution from Partner 7 (CSIC)

CSIC will focus on 2 major topics:

- probing inflation, topological defects and dark energy using Markov Chain Monte Carlo (MCMC) sampling and
- large scale structure simulation for the study of reionization and gravitational lensing.

I. Cosmological appications of MCMC sampling (R.B. Barreiro, E. Martínez-González, P. Vielva):
To perform the proposed applications (see below) we will use the publicly available code CosmoNest (developed by Mukherjee, Parkinson & Liddle) which is an extension of the publicly available CosmosMC code developed by (Lewis & Challinor). This code allows one, first, to explore a complex parameter-space, by using two different techniques of sampling: Metropolis and Nested sampling. In addition, the code implements as well a tool to compute Bayesian evidence for model selection. CosmoNest is coded in Fortran 90 and uses LAPACK and CFITSIO libraries and is parallelized using standard MPI and OpenMP

libraries. In addition, it has been largely tested on several platforms (e.g. Linux/Unix, Mac, Suns, Alpha, …).

I.1 Non-standard inflationary models:
Non-standard inflationary models predict small deviations from the Gaussian distribution of the density matter perturbations. If this is the case, one should detect associated deviations from Gaussianity in the cosmic microwave background (CMB) temperature distribution. A large family of inflationary models can be described as a second order perturbation of the primordial gravitational potential, whose amplitude (f_{NL}) is, in general, scale-dependent. Up to now, due to complexity on generating and analysing these generic models, a constant value with the scale has been assumed for f_{NL}. This project proposes to characterise the scale dependence of f_{NL} by a given set of parameters and to constrain them through massive sampling. This will imply an important breakthrough on the field.

I. 2 Topological defects:
Recent CMB analyses have suggested the possible existence of topological defects, in the form of textures, that would contribute (in a small fraction) to the large scale formation of the universe. Therefore the search for this type of topological defects on current and future CMB data is of great interest to confirm or discard these subdominant models of structure formation. Also their sole existence would have a profound impact on our ideas of the universe and in particular would provide more support to unified theories of high energy physics. This work would imply the localization and characterisation of a given number (around 40) of objects of different angular scales on CMB maps. Typically each one of these objects is described by four parameters, which obviously require the use of MCMC sampling and large computing resources.

I.3 Dark energy equation of state.
One of the most direct ways for detecting the presence of dark energy is the cross-correlation of the large scale structure (LSS) with the CMB temperature fluctuations through the well-known integrated Sachs-Wolfe (ISW) effect. In a geometrically flat universe a positive correlation between these two observables constitutes an evidence of the existence of dark energy. This way to detect dark energy has been successfully used, allowing one to constrain as well the cosmological parameters that define its properties. Among them, the equation of state parameter (w) is one of the most interesting since it may help to distinguish among competitive dark energy candidates. However, in order to extract all the valuable information contained in w, a detailed study of the CMB and LSS as a function of the redshift is crucial. In this project we aim to explore this possibility of discriminating among dark energy candidates which would imply, on the one hand, the generation of coherent CMB and LSS simulations and, on the other hand, the determination of the dark energy parameters via MCMC sampling.

II. Large scale structure simulation for the study of reionization and gravitational lensing of the CMB (J.M. Diego).
The second topic of this scientific project is related to one of the most outstanding fields in cosmology: the simulation of large volumes of the universe and the study of different phenomena that can only be properly analysed using these simulations. In particular, there are two effects related to the interaction between the CMB photons and the LSS that we aim to

investigate. First, we propose to study in detail the CMB photon deflections by the gravitational potential along their path from the last scattering surface to us (lensing), to predict the expected pattern imprinted on the CMB temperature and polarization maps as well as on the CMB angular power spectra. Second, the effect of the interaction of the CMB photons with the ionised regions of the universe at the reionization epoch will be studied. Given present CMB data we aim to constrain the history of reionization which occurred at about redshift 10 and also make predictions for the CMB anisotropies at arcminutes angular scales. The study of both effects, lensing and reionization, requires the use of efficient and flexible simulation codes, like the publically available GADGET-2, to perform hydrodynamical simulations with a resolution of several tens of Kiloparsecs and covering scales of about a hundred Megaparsecs. The generation of these large volumes of the universe with fine resolution requires huge parallelised computational resources. GADGET-2 is a Tree-SPH (Smoth Particle Hydrodinamics) code which has been widely used in Gpc scale hydrodinamical simulations (the largest simulation up to date, Millenium, was made using this code). The code is parallelized using standard MPI libraries and it is optimized for fast computations of the potential (inversion of the Poisson equation in Fourier space). The code needs to be modified to include the light-cone effect. The simulations planned for this project will require of the order of 10^9 particles. A simulation with such a high number of particles will need tens or even hundreds of CPU’s with shared memory. A large storing element (few TBs) will be also needed to store the simulations.

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Votre référence/Your reference:
Notre référence/Our reference:LoS AGENA

Dr. Fabio Pasian
INAF information Systems unit and
INAF – Osservatorio Astronomico di Trieste
Italy

Geneva, April 20, 2007

Dear Dr Pasian,

This is a letter to show my support for the Access to Grids Enables Astronomical research (AGENA) project proposal. On behalf of the EGEE consortium, I wish to confirm our willingness to work with the AGENA project which plans to coordinate groups who are active in astronomical research and who are already using the grid for the computational needs and to provide grid access to those scientists who have not deployed their applications on the Grid yet.

EGEE is looking forward to providing support to new users from the Astronomical community. EGEE can offer access to the GILDA testbed and training courses and we hope that your partners will visit EGEE experts and attend EGEE events in order to enhance exchange between developers and users.

EGEE is integrating national, regional and thematic computing and data Grids to create a global Grid-empowered infrastructure for the support of several scientific applications. The AGENA proposal will give EGEE an excellent opportunity to work with a very interesting user community, and thus give us useful input on our infrastructure.

The EGEE consortium involves more than 90 leading institutions in 36 countries, federated in regional Grids, with a current combined capacity of over 20’000 CPUs, the largest international Grid infrastructure ever assembled.

My colleagues and I look forward to the opportunity of a fruitful collaboration and wish you and your project the best of luck.

Yours sincerely,

Bob Jones
EGEE-II Project Director

Observatoire astronomique
de Strasbourg

UNIVERSITÉ LOUIS PASTEUR
STRASBOURG

Strasbourg, May 2,2007

Dr Fabio Pasian
Osservatorio Astronomico di Trieste

To whom it may concern

The Astronomical Virtual Observatory, implemented in Europe by the Euro-VO project, is relying on generic *e*Infrastructure elements, in particular GÉANT and the European National Research and Education Networks. Some of its applications may have to use the processing capabilities offered by the computational Grid projects, and a Work Package of the on-going FP6 Euro-VO Data Centre Alliance Coordination Action aims at assessing possible coordination with computational Grid project. This usage is only one among the many possible uses of the computational Grid by the astronomical community, and Research Activities on Interoperability between the Grid and the Virtual Observatory is thus one of the topics of the AGENA project.

This topic (interaction with the generic Grid infrastructure) is not included in the *Euro-VO Astronomical Infrastructure for Data Access project* (EuroVO-AIDA), which is submitted to the Scientific Digital Repository Call and deals with topics relevant to that call.

Best regards,

Françoise Genova
Coordinator of EuroVO-DCA and of the EuroVO-AIDA proposal

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