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Apprenticeship Environment and Co-operation Based on the Grid and Web 2.0 Designed for Training Communities with Common Interest Centres

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Common interest centers specialized in training communities, such as secondary schools, university training institutes, have heterogeneous, rich and varied resources in contents. Yet in their assessment, these communities present very disproportionate results. The present article comes out with an apprenticeship and co-operation setting which is based on Grid technologies and uses Web 2.0. The new environment is designed to ease the communication between the communities and thereby reduce the gap between them. To achieve this objective, a set of technologies and tools is used. It includes domain ontology for the validation of course contents, intelligent agents for communication and guidance, extended Moodle platform for contents surfing, multimedia message services (MMS) for transfer and retrieving grid courses through the mobile phone.

1. Introduction

Today, emerging technologies like the grid and web 2.0, significantly improve access to resources. For instance with grid, it is possible for a user to run in a transparent manner a software in a remote computer without having to worry about material or software constraints (capacity of the processing unit, memory, computing power, etc.). That responsibility is incumbent on the grid load. Web 2.0 on its part enables the internet user to impact on the contents that it receives, thereby making him not only a mere consumer, but also a producer of resources. These characteristics of the grid and web 2.0 meet the present requirements of e-learning consisting in the collaboration and co-operation between all the participants and the learner as the centre of his apprenticeship.

Furthermore, many training communities that share common interests like secondary schools and universities have numerous, heterogeneous resources rich in contents. Nevertheless, the problem encountered in reviewing these communities is that the latter present, for the same course contents, disproportionate results. For instance, in Cameroon, for the same national result, the success rate is some times far above average for certain schools and below average for others; this particular case can be observed through the statistics of the 2007 official exams published by the “Office du Baccalauréat du Cameroun” [BEBC 2008]. In order to reduce the gap between these communities, our hypothesis is that, resources of each of these communities reside in the computer connected on the Internet. This article thus puts forth an apprenticeship
and collaboration environment named « Grid Environment for Learning and Sharing Objects between Training Communities » GELSOTC, designed to facilitate inter-community communication.

GELSOTC is based on the grid infrastructure. It federates the following tools and technologies: domain ontology for the research and the validation of contents, intelligent agents for communication and tutorship, Moodle platform extended by a module of content structuring and Web 2.0 concepts for contents surfing, and Multimedia Message Services (MMS) for depositing and withdrawing grid lectures via the mobile telephone. Its main objectives are:

- To enable training communities with common interest centres to gather in networks in order to exchange training resources, create and put at the disposal of the network consensual contents, pedagogically rich and varied, to validate contents created by domain ontology, etc.
- To enable constituted members of networks: to learn, enrich various training contents of their networks, organize themselves into self aid groups, and seek available resources of their networks.

We have structured this article as follows: the first part presents the state of the art on the field of grid services for learning, a glance at the Web 2.0 and its advantages for e-learning, a glance at the Moodle platform, a brief definition of the ontology and the intelligent agent. The GELSOTC environment is specified in part two while the third part concerns the implementation of GELSOTC middleware. The article ends with a discussion, a conclusion and some perspectives.

2. State of the Art

2.1 Computer grid and its apprenticeship capacities

2.1.1 Grid computing.

From the numerous definitions of grid computing, we have retained Ian Foster and Keselman’s who define computer grid as an environment operational and heterogeneous architecture systems whose access is provided to the user under a unified form by a software called Middleware [Foster 2001, Batchakui and al. 2007]. The grid is often used to share free computing power of connected computers. It is based on a standard architecture called OGSA (Open Grid Service Architecture). It deals with architecture in layers whose services form the basis of communications [Dugenie 2005, Kesselman 1998]. OGSA has a series of technical specifications which help to define an infrastructure in order to integrate and manage services within an organisation which is virtual, spread out and dynamic [Foster et al. 2002].

Today, grid usage has spread out to other domains. However, our interest is on e-learning. Apprenticeship grids as they are often referred to help to share out learning resources, give room for the inclusion of constraints such as : “information access only when the need is expressed, the management of the access to the distribution network and safety. The above-mentioned constraints constitute the requirements of a learning
model on information transfer. Apprenticeship grids are, on an architectural point of view, based on the OGSA extension called GLS (Grid Learning Services) [Nkambou and al. 2005]. This is an OGSA to which a layer has been added comprising basic services that enable sharing as perceived by e-learning (collaboration, e-qualification, co-ordination, etc). The objective of GLS is to facilitate the contents broadcast and the sharing of apprenticeship objects. Grid presents so many advantages for apprenticeship.

2.1.2 Advantages of the grid for teaching.

The grid is supported by a distributed architecture, as solution to the problems of the interoperability and heterogeneity. Its advantages are numerous. It permits: the access of a larger number of learning objects geographically dispersed, the coexistence of heterogeneous resources, the dynamic management of learning resources, the reduction of costs related to maintenance, the sharing of resources to enhance the collaboration between learners and the authors of the learning objects [Pankratius 2003], the sharing of the knowledge of the learner personalized and contextual. Also, it creates a learning environment centered on communication and collaboration and consequently, reduces considerably the distance between the entities or actors of the training.

2.1.3 The grid environments for Learning.

Grid systems have been conceived in the domain of e-learning and their main objective is to enable their users to collaborate through exchange of learning objects. The stress this time is put on the learner: the systems designed save the latter from the overload of information in registering into the virtual organization and the contents offered take into account the profile of the learner. The environments that we have studied, those that have mostly struck us with respect to our objectives are the following:

- **DIOGENE [Cri 2002, Wooolf 2005]**: it is a platform resulting from a project financed by the European Commission which has as objective to design and realize an innovative environment for the brokerage of the online training services, then evaluate it in real situation. It serves as a support to the learner all along his learning process, from the definition of the objectives up to the validation of the results, passing through the construction of the personalized training channel. It offers innovative functionalities, for example, the probabilistic modelization of the learners, the personalized adaptation of the training channel, cooperative learning and online guidance, the intelligent and assisted definition of the training objects, dynamic learning strategies, the management of learning objects, etc. The technologies used are metadata and ontologies.

- **Custumized Grid Learning Services [Wooolf 2005]**: it uses the techniques of web semantics, ontology, and autonomous agents to supply a personalized approach of the services of the learning grid. The learners and the teachers access the course according to their profile.

- **GRID-e-CARD [Gouarderes 2005]**, which is a system based on the grid infrastructure and a set of P2P agents with the objective to bring together,
in Virtual Learning Communities (VLC) the actors or entities of a learning environment on the basics of their signatures (knowledge acquired, future objectives, desired learning services, ...) for collaboration purposes.

- DyColo (Dynamic Collaboration Learning Object), is a collaboration platform based on the Grid Learning Service which permits the learning entities and teachers to collaborate with the particularity that the entities which share resources are grouped together thanks to the services of e-qualification integrated into the GLS [Mireille 2006].

The contributions presented above are indeed very interesting but for most past not yet effective. The groupings proposed for these environments are virtual organizations with the inconvenience that they can have a very high number of members which does not ease proximity learning. Practically there exist no environment that offers the possibility to the communities having the same centre of interest to be grouped in order to join their efforts to converge towards the best results when they are evaluated.

### 2.2 The Web 2.0 and its advantages for e-learning

The Web 2.0 is an information-pooling concept which modifies our way of working and interacting with information. With the Web 2.0 the user is at the centre of the exploitation of the information given that he participates actively in the enrichment of the content that he receives. Contrary to the Web 1.0 which proposes only internet pages to be consulted, the Web 2.0 allows the user to react to information found on the internet. Access to the tools is at the centre of the utilization of the Web 2.0 for education: for example we have, wikis, blogs, RSS lines, aggregators or personalized welcome pages [Dremeau 2007].

Learning is said to be effective when the activity of the learner is highly solicited, hence the necessity to reinforce the teaching model in use by pedagogic strategies that permit the student to be at the centre of the learning process. The Web 2.0 offers the possibility to the actors of the training to impact the content, through their remarks and annotations. It provides the learner with a flexibility and a certain learning autonomy. For example the learner can subscribe as a student to the RSS streaming to benefit from updates of the learning domain.

There exist environments of e-learning based on the Web 2.0, including among others [Dremeau 2007, Perruzza 2008, Thomson 2005]:

- “Wikipedia”, which is a freely distributable online encyclopedia project that any user can ameliorate. The content proposed is published under GFL (GNU Free Document Licence),
- “edtags” where teachers and students list the links and articles that they put at the disposal of the community,
- “google for educators” from Google which provides educators with a space where they can find all the google applications, tools and services used for pedagogical aims,
• “facebook” which permits the learners to exchange their notes and courses,
• “Podcast” of American Universities which distributes in audio or video forms their courses on the Net.

The content is the central resource of a learning environment. Putting the course files online is not sufficient, we need to think of an actual intelligent space to use the content. We saw that there exists a solution with the platforms based on Web 2.0 but these platforms do not refit on a grid infrastructure, consequently their usage depends on the system that shelters them.

2.3 Brief general idea of Moodle

Moodle is an Open Source environment of e-learning, developed by Martin Dougiamas and the Moodle community. It manages the contents and creates interactions between teachers, learners and pedagogic resources through the network. It is within the pedagogical logic of the social constructivism that postulates that knowledge is constructed in the mind of the learner and not retransmitted in a static manner through textbooks or trainers [Wikipedia 2008]. The management tools are centered on the following principal modules: user, course management, test, assignment, wiki, opinion, and forum.

Moodle is more generic than the web 2.0 based environments cited above. It has indeed interesting functionalities for an e-learning environment, yet the learner-content interaction remains a problem. Indeed, the lessons available on this platform like in many learning environments are in the doc, pdf or html formats. In fact, a course is a set of knowledge units (or notions). From this viewpoint, the follow up of the learner is reinforced if the teacher has the possibility of presenting to the learner the content that brings him gradually to the end of the fixed objectives. This is only possible with a structured content. Our contribution is therefore to reinforce the learner-content interactions by integrating to Moodle, a transparent module for the user capable of transforming all non structured content to structured content accompanied by a navigation interface in the content based on web 2.0. xMoodle obtained has just by its structuring reduced the cognitive load of the learner and reinforces the learner-content and teacher-content interaction of Moodle. Consequently, it reduces to a greater extend the transactional distance [Moore 1996].

2.4 Ontology

The ontology tackles the problem of reuse and sharing of knowledge while privileging the explicit representation of the sense. It is defined as an explicit and formal specification of a conceptualization of a domain of knowledge making the object of a consensus [Gruber 1993, Pierra 2003]. It permits among others: the communication between humans for it favors the sharing of terms, the communication between humans and the enterprise for it standardizes the vocabularies, the indexing and the research of information.
To facilitate the understanding and the sharing of the knowledge between training communities, we need a tool that allows the actors to be okay on the terms they use. A learning environment has to permit the learner to access easily the concepts which he needs. The courses put at the disposal have to respect the standard defined by the communities that collaborate. In the framework of the present collaboration environment, we have chosen the ontologies to respond to this problem.

2.5 Intelligent agent

There are several definitions of an agent. Within the framework of this present work, we will choose that of Wooldrige and Jennings who define an agent as a computer system, situated in an environment, and that reacts in an autonomous manner to attain the objectives (goals) for which it was designed [Wooldridge 1995]. An agent is said to be intelligent when it is conceived to execute tasks based on its proper knowledge and message that it has received.

The agent service of GELSOTC comprises two types of intelligent agents:

- A recommendation agent: It plays the role of tutor; he helps the learner by conducting him to the end of his initiation. For example advise a learner a particular work group that can help the latter.

- A notification agent: It sends notification messages to the members that collaborate. For example, he can remind a group of the work which they took an appointment to work, specifying the planning which the members of the group established and even the theme on which they promised to debate. It sends messages to mobile phones of members and by e-mail.

Our contribution is a solution to the collaboration between heterogeneous environments through our infrastructure of the grid. Consequently, it favours the collaboration between the intelligent agents of the systems connected to the grid. A recommendation agent of a given system can for example solicit the support of a recommendation agent of another system. We will detail these concepts of “grid-agent” in the framework of another article.


GELSOTC is a software collection that regroups a platform of content management called “xMoodle 2.0” and the GLS services:

- « xMoodle 2.0 » is the extended Moodle plate form based on the Web 2.0. Extended for it is being integrated complementary functionalities that comprises: a navigation interface in the content of the training, a service of a particular group called the study group, and a forum adapting the present context of the collaboration.

- The services of GLS are among others:

  - The collaboration: It is a conversation process that goes beyond a simple exchange of information for it takes into account the social context of learning. Collaboration implies the adhesion of the community, the
distribution of tasks, and the sharing of knowledge in order to attain a common goal. As an example of collaboration in the framework of this work, we have the service “ontology of the domain”. The other collaboration services as instant messaging, electronic conferences, the forum, and the study group are integrated into the xMoodle 2.0;

- Communication: when it has to do with direct communication between the actor entities (humans, hardware, or software) of GELSOTC, we talk of a peer to peer communication; in this case software agents are used for communication. For example the agent of recommendation plays the role of counseling and the agent of notification informs the learner of the rendezvous in a study group. More so, Multimedia Message Services also enable the communication with the server towards deposit and withdrawal of content.

- E-qualification: it enables the individual evaluation of the actors during their evolution within their community. To this effect, it provides the learner with the best virtual organization, i.e. that corresponds to the learning profile.

3.1 Objectives of GELSOTC

The objectives of GELSOTC are situated at two scales: a macroscopic scale where it has to do with laying emphasis on the activities carried out in each training community; and a microscopic scale where there is the need for the exploitation of the existing services in order to respond to the needs of the distribution of the learning objects of the different communities.

3.1.1 Macroscopic Scale.

On the macroscopic plan, GELSOTC puts at the disposal of the communities a common centralized unit called xMoodle 2.0. This is an extended Moodle[Wikipedia 2008], comprised of a structuring module of the contents and a web interface reusable to navigate in any structured and shared content of our learning environment.

GELSOTC establishes relations between the following five types of actors: the learner, the teacher, the author, the manager of the community, and the administrator. Seen from the community angle, it enables the constituted collaborations network to:

- publish the pedagogic contents (courses, evaluation, etc) of the different communities,
- share their seminars and pedagogic meetings through the video conference service,
- organize evaluation sessions between the training levels,
- inform a given community on its evaluations through statistical data,
- Propose their laboratory or their library through the virtual reality service,
- facilitate the availability of competences through the services of recommendation agents.
• Inform the learners, teachers, or community managers of the availability of important resources: ensuring a permanent technological watch with respect to a particular need of the moment. The actors receive, when necessary, information through their mobile phones and they can equally access contents through the same channel.

3.1.2 **Microscopic scale.**

On the microscopic plan, with a regard to the actors of the constituted network, GELSOTC enables the latter to:

• constitute themselves in study groups comprising learners from different communities. These learners can plan their study sessions and be notified of the program and the study time through their mobile telephones by the notification agents of the system.

• to access resources of their study level in the constituted network. For a given study level of the network, we have as much content as the communities of the network,

• to access tutor-type resources or assistance through the recommendation agents,

• to navigate in varying course contents validated by the ontology of the domain,

• research learning resources through a research service based on the ontology,

• visualize the learning objects belonging to their virtual community,

• etc.

3.2 **General functioning**

3.2.1 **Logical architecture of the GELSOTC interconnection.**

The communities connect to the GELSOTC server and form with it the Grid. The network thus constituted consists of a server, the set of computers of the communities, individual computers, and mobile telephones. The Figure 1 presents the logical architecture of the constituted network.
At the middle of the above architecture (Fig. 1), we have a principal server, which will contain common services, for example the management of the learning content xMoodle 2.0, the service of “recommendation agent”, etc. At the peripherals we have the secondary servers that represent the training communities that constitute a collaboration network (C1,C2,C3,…,Cn).

There exist three forms of connections to the grid:

1. A user can be connected to the grid from a post of the local network of his training community. For example the post P1 of the community C1 (P1.C1).
2. A user can be connected to the grid through his personal post. For example the post Pi of the grid (Pi,G).
3. A user can be connected to the grid from his mobile telephone. For example the post PT of grid (PT.G). The connection through the mobile telephone passes through a GSM modem that is not represented in the diagram. This form of connection has a very important role for a country like Cameroon in which the use of mobile telephones is expanding day after day. The communities that don’t have internet can connect to the GELSOTC server through heir mobile telephones[Djotio 2009]. A stock zone is reserved to them to allow them stocking their resources. And so we can constitute a virtual grid. More so, the users can access the content, receive notifications or latest information using their mobile telephones.

Such an organization in terms of interconnected equipments is mapped a logical organization of the human entities that constitute the collaboration network. This second form of organization that present the functional view of GELSOTC is represented by Figure 2 below.
3.2.2 General functioning diagram of GELSOTC

Figure 2 is a set of two big blocks:

- a block “clients” composed of four entities: the user, the study group, the virtual community, and the training community:
  - The user is a qualified user (the system masters its profile); he is either a member of one of the communities or a guest to the grid.
  - The study group is a regrouping restricted to at most 5 learners of the constituted network who have decided to work program in common.
  - The virtual community is similar to the virtual organization, it has to do with a regrouping of persons having the same profiles around the same resources. The number of members is unlimited.
  - “Training community P” represents a community in the real sense that has decided to form with some of its peers a collaboration network.
• a block “System” is composed of layers of the grid infrastructure: a lower layer composed of physical and logical resources (data and resource servers); a middle layer (Middleware) based on the standard OGSA; a GLS layer comprising the collaboration services, communication and e-qualification, etc; and the GELSOTC layer that is the shop-window or the interface with the user.

3.2.3 Use case diagram.

Figure 3 presents the use case diagram. The user interacts with the system through the services. He can be a member of a community of the network or not, however he integrates one of the following five roles: learning, teaching, author, community manager, and administrator.

Fig. 3. Use case diagram
3.3 Technical Architecture of GELSOTC

GELSOTC has a layered technical architecture as represented by Fig. 4.

Figure 4 is essentially made up of three functional blocks:

- A central bloc composed of:
  
  - An authentication layer that permits the interconnection of guests or communities to the Grid.
  
  - A MiddleWare Grid layer which is the central element of the grid, in charge of communication and data transfer between the computers, components or programs. It is composed of the layers of the architecture.
  
  - A GLS layer that comprises the services of: ontology of the domain that validates the content, recommendation agents or tutor counselor and the notification agent, MMS (Multimedia Message Services), etc. This layer is the centre of the collaboration service, of e-qualification, and communication.
  
  - An application layer, which is composed of the xMoodle 2.0 services. xMoodle 2.0 is an LMS (Learning Management System) that is situated at the heart of GELSOTC because it provides contents. It integrates a study group and an interface based web 2.0 used to navigate in contents.
• A peripheral block in the direction of the compound communities:
  o An authentication layer that permits a guarantee of security of access to the resources of the customer.
  o A Middleware layer, in charge of the communication and transfer of data between the computers, components or programs.
  o An agent layer composed of a management agent of the connected community who is the virtual representative of the community, and an actor agent that represents the user of the community connected to the grid.
  o A layer of services or shared objects that the community makes available in the framework of the collaboration.

• A peripheral block in the direction of the user: these users have at their disposal internet connection on their working places and are connected directly to the grid; the users that don’t have internet can be connected to the grid from their mobile phones.

4. Implementation and Results

We have presented in the section 3.3 the layered technical architecture of GELSO TC. The heart of the present environment is composed of the GLS and the middleware layers. Now our interest is centered on the implementation of the middleware layer. We have opted in the framework of this work on the association of technologies JINI and RMI. So, our middleware is essentially composed of the sub layers RMI, JINI, and communication.

4.1 The RMI sub layer

It is the basic middleware sub layer. RMI (Remote Method Invocation) is a mechanism for the invocation of a remote object method. It is an evolution of RPC (Remote Procedure Call) [Sun 1999]. It is application of the JAVA object methods. With RMI, each remote object needs the use of stub by the client and a skeleton by the server for the good functioning of communications. For our middleware, RMI is used transparently by JINI. The generations of stub, skeleton and the registering in the RMIRegistry are under the care of JINI mechanisms.

4.2 The JINI sub layer

JINI is an API developed by SUN which adds to the JAVA programming model the notion of service [OAKS 2000, Sun 2000]. A JINI network is generally called a community in the sense that it regroups the entities that have access to each another. We distinguish principally two types of entities: the service and the client. The service is an entity capable of realizing a certain task for the set of entities that are members of the community. The client on its part uses the said services. Each community regroups its members around a centralized service called lookup. Its principal role is
the management of the discovery of services that are found around it. Its participation as an intermediate communication entity between the client and the service, is limited to the discovery process. Once established, the communication is carried out directly between the client and the service. From a technical point of view, JINI offers a software infrastructure, permitting the JAVA objects, called services, to discover and use themselves spontaneously.

4.3 The communication sub layer

The sub layer of the communication service allows principally the management of resources. It establishes the link between JINI and the resources of the communities. In fact, JINI services invoked in the previous section are considered here as resources. The sub layer of communication service allows the display under a tree form all the resources of the machine on which it is installed and equally the communities connected to the grid. It also permits the management of resources by loading them into a sort of warehouse (for example a folder of the machine on which is launched the intergiciel and which is visible in the JVM classpath).

4.4 Results

The middleware that we have developed are installed on the servers of the community and the principal server. Putting in place the middleware needs the installation of the pile of layers presented (RMI, JINI, and communication) on each server. In a practical manner, in each server runs a Lookup service for the registration of resources that the members of the community will publish. The grid is realized in such a way that when a Lookup is added or deleted (which means that one server is off, removed from the grid or started), then all the components of the middleware situated on all the other posts (principal or community server) are notified and the bank of resources available on the grid is updated. In this way, the user can therefore notice that new resources were added or have disappeared. At the level of each community or of the principal server (the machine on which is installed xMoodle) the authorized user can add or remove resources. The description of these resources will be registered in the corresponding Lookup.

Figure 5 presents the access interface to the resources of the communities of the network. It has to do with the view of a connected community: we note the presence of xMoodle, the resources of the community, and the resources of the central server.
In this interface, the “Resources” menu allows the management of resources (updating of resources). The “Refresh Tree” allows refreshing and shows the communities which are connected to the grid with time.

5. Discussions

GELSOTC is a platform designed to allow the constituted training communities to form networks of help: the communities can put at the disposal of their members, pedagogically rich and varied training contents. It is used to increase the performance of the communities of the constituted networks.

The main idea is to transplant an application of content management on a layer of the basic services used by the learners and teachers in training situation:

- The learners through their computer reach the different communities where they find the corresponding resources to their profiles. They sail in a transparent manner in the contents formation without worrying about the system that shelters these contents.
- The teachers using their computer to put their teachings at the disposal of the communities. They can converse with the learners who are connected.
- The communities through their manager put at the disposal of the other communities a software resource, for example a virtual laboratory and virtual library.
The specifications above show that GELSOTC would like to transform the office of:

- The learner in a virtual class. The learner can: have several teachers in his class, converse with the learners of his level, and especially form a study group with the learners of his choice.
- The teacher in a virtual school with virtual classrooms where he offers some teachings. The teachers can put their lessons at the disposal of the students of a given level, receive the feedback on the teachings published, teach several learners at a time, communicate with communities managers on pedagogical topics, etc.
- The community manager in a virtual school where he manages learners, teachers, and resources at his disposal for a good running of the school. He can put at the disposal of the other communities the educational resources, inquire about the evolution of a virtual given class of his community, etc.

When we refer ourselves to the computer grid, it follows that the user can access in a transparent manner the resources which he needs. The above description shows that the actors don’t have to give an account of the technical disposals that permit them enjoying the resources put at their disposal. Consequently, GELSOTC wants to be a model of Grid for Learning Management Systems (GLMS).

6. Conclusion And Perspectives
The present work is the integration within a single environment that we have baptized GELSOTC, a technology of grid and Web 2.0 concept. The proposed environment allows regrouping the communities into a common centre of interest in the mutual-aid network and to widen to the maximum the exchanges between these communities. Therefore this provides the needs in educational resources of the communities of the networks formed. The communication and the interaction between the members of the different communities of formation are improved thanks to a panel opened to collaboration services:

- The learners of the different communities of the network have the possibility to collaborate following their knowledge level: they can share the points of view on a common topic from the forum, they can constitute a study group. At the time of the sessions of collaboration within such group they can contribute to the enrichment of the content.
- The trainers of the communities have the possibility to harmonize their teaching at the end of the assessments made in common in the network of exchange or proposed in the different communities, to bring their suggestions on the contents proposed by their colleagues.
- The managers of the communities have the possibility to share their experience with their equals, to value their own community of formation from the results of assessment common and statistics of evolution of the learners in the groups of survey formed, etc.
This work is a contribution to the value added conception of a Grid Learning Service (GLS) (with the presence of services as MMS, the study group, etc.). It reduces the transactional distances between the members of the grouped communities and consequently reduce the gap between them. We are very much interested in the specification of GELSTOC. The continuation of our works will be on the implementation: first the implementation of the middleware that coordinates the activities of the grid, and next the implementation of the interface layer (IHM of navigation in resources) and basic services such as the agent and ontology services. The project will end with the gradual integration of the usual collaboration services as messaging, chat, study group, etc.

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