Learning Grid

kaleidoscope
concepts and methods for exploring the future of learning with digital technologies

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In this Issue:

1 – Editorial

2 – State of the Art on Learning Grid – Historical Perspective

4 – State of the Art on Learning Grid – Technological Perspective

7 – State of the Art on Learning Grid – Technological Trends

9 – State of the Art on Learning Grid – Cognitive Perspective

12 – State of the Art on Learning Grid – Social and Cultural Perspectives

14 – News form the SIG Workshop "Next Generation in Technology Enhanced Learning"

15 – News

16 – When, What, Where?

Editorial

One of the tasks of Kaleidoscope is to present a state-of-the-art description of the accomplishments in the different fields of Technology Enhanced Learning and to be able to use this to inform policy at different levels.

The Learning Grid Special Interest Group contributed to this effort by providing a state of the art document about the Learning Grid field based on multiple perspectives such as:

- **historical perspective**, i.e. the historical development of the field and how it is related to Grid Technologies;
- **technological perspective**, i.e. the state of the art about technologies that make possible the vision of the Learning Grid;
- **cognitive perspective**, i.e. an analysis of what the individual can learn through a Learning Grid and which kind of new learning activities are possible;
- **social and cultural perspective**, i.e. how Learning Grid impacts at social and cultural levels, e.g. changes that should be made at schools, universities, workplaces, etc. to support the Learning Grid;
- **future trends**, i.e. which advancements are foreseen for the next future in the field.

Together these perspectives tries to provide a set of accomplishments that can be used to describe evidence of changing conditions and effects of Learning Grid in the more general context of Technology Enhanced Learning.

The main findings of this exercise have been included in this newsletter with a series of five short articles written by several members of the SIG steering committee (according to their specific research interests) focusing on each one of the mentioned perspectives.

A further article is dedicated to the joint workshop "Next Generation in Technology Enhanced Learning" organised in Barcelona in the context of the eChallenges Conference by our SIG in conjunction with the ELeGI project.

About 25 participants had taken part to the half-day workshop with five interesting talks on topics related to Learning Grid.

Workshop papers are available, as other eChallenges papers, in the book "Exploiting the Knowledge Economy: Issues, Applications and Case Studies", Vol. 3, Information and Communication Technologies and the Knowledge Economy, P. and M. Cunningham eds., IOSPress.

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State of the Art on Learning Grid

Historical Perspective

The purpose of this short article is to outline the historical development of Grid Technologies and to contextualise the Learning Grid field. This reading will be useful to better understand next articles of this issue focused on new achievements and trends of the field.

1. Introduction

To have a complete view about the Grid and its beginning it is necessary to provide a brief historical perspective of the whole Internet. In the first chapter we will travel across the time line from the initial steps to the current situation. Then, the second chapter will focus on the evolution of the Learning Grid concept.

2. Brief History of Grid

The historical development of the Grid field is relatively short (around 30 years of history are enough to describe the current framework). In fact, the use of the term Grid itself is about 20 years old.

In 1969, ARPANET (Advanced Research Projects Agency Networks) was built with a speed of 50Kb/s and the first international connection to it was in 1973. The same year, there was the first Ethernet demonstration and only two years later a TCP connection over satellite was developed.

Internet (term that, in fact, was defined by 1982 as connected TCP/IP nets) grew dramatically since its beginning. By 1984 there were 1000 computers connected to the Internet and only three years later the number was increased by one magnitude order. Only one year later this number was multiplied by six. During the eighties the total amount of computers connected to the Internet was so high (and its growth was so rapid) that finding a specific computer became a very difficult task. This motivated the creation of the DNS (Domain naming system) that allows the identification of any computer connected to the Internet.

By 1986, the NFSNet (National Science Foundation) substitutes ARPANET as governmental network between universities and research centres; it was created with a backbone of 56Kbps. The basic structure for this network was composed by six big computers and six “small brothers” called fuzzball that from the very beginning communicated using the TCP/IP protocol. By the same year, the IETF (Internet Engineering Task Force) is created. The IETF was an international organisation with the aim to develop the architecture and the functionality of the Internet.

1988 is a very important year for the full development of the Internet. This year, the NFSNet backbone reaches the 1,5 Mbps, IRC (Internet Relay Chats) appears and the Condor project starts. The beginning of the Condor project is a very important milestone in the Internet development. By the end of the decade the US government realised that it was impossible for them to fund the use of the communication networks and encouraged MERIT, MCI and IBM to create a non-for Profit Corporation to provide this service to the users. This resulted in ANS (Advanced Network and Services) that by 1990 took the NSFNET and created the ANSNET with a backbone speed of 45Mbps.

To follow the evolution of the Internet and the Grid it is necessary to not follow the line of the Internet itself anymore and to go back to the Condor Project. The Condor Project (High Throughput Computing) was mainly a specialised workload management system. The jobs to be done by the system were queued and condor decided which job should run in each moment reporting also to the user.

The Condor Project was conceived to allow the collaboration among different machines within the same department. It was designed to cope with the processing needs of the different procedures (selecting the best option among all the available machines) and also with possible failures of any of the machines. Condor was robust, able to deal with non-ending tasks and also with the inclusion of new machines in the network.

Taking into account these features, Condor could be seen as the initial seed for the current Grid. Condor’s limitations were mainly related to the need of having all the machines in the same administrative domain (at the very beginning it was limited to a local area network).

At this point it is necessary to make a stop in the time line of the evolution of the technologies to understand why the Grid appeared and how the concept evolved until the current situation.

The access to the Internet became easier and cheaper only in a few years. Computers became more powerful and the processing speed higher. Most of the computers that we had spent the whole day connected to the Internet with a minimum use of their CPU possibilities and with a quite secure protection.

In this scenario, would it not be desirable to be able to access another computer (a remote machine with a higher computational capacity) in case of experiencing a very consuming computational problem that our computer cannot solve?

Using the Grid it is possible to solve our problem with a remote machine that has accessible more powerful computational resources. The access to these capacities is done under a secure and trustable connection and allows sharing results and solutions among research teams and technological groups around the network.

Following the time line, by 1993 the Legion Project was released. This project proposed a Grid Object Model (everything is an object and has its own methods, parameters, etc) with the final aim to present all the machines as only one virtual machine where all problems may be solved. However, this model was quite difficult to implement and although there were some successful applications created, it is still not possible to easily transform several applications to the object oriented model.

By 1998 Globus appeared in the scene, which is nowadays still in the leading edge of the Grid technologies. Globus Project (www.globus.org) released the leading Grid toolkit. It offers not the Grid net itself but the tools to create and maintain the network. It defines and implements standards for important aspects such as security and access among others.

From 1998 on, some important projects related to the Grid have started and contributed to the research in the field. Furthermore the possibilities offered currently by this technology and the application areas where they can be seen, as for instance, e-learning, is still growing.

2. Grid in e-Learning

The use of the Grid for e-learning applications is quite recent (the time period considered is about eight to ten years) and the real starting point of work in the area can be dated in 2000.

The Grid solution is very suitable for the e-Learning field because it opens new possibilities of improving the teaching/learning process and it also means new methodologies and contents for students. It enables collaborative settings for education (sharing data and pedagogical methods) and it represents the last step of the entrance of Information and Communication Technologies in the e-Learning field.

Since 2000 the entrance of the Grid in the e-Learning field has been fostered by different projects world wide. Most of these projects have been released by educational institutions (isolated or under a joint collaboration) and have produced results contributing to the scientific community.

In Europe, most of the research projects carried out in the field have been launched by particular educational institutions or under research programs as for instance the Information Society Technologies (IST) Research and Development Programme of the European Commission.

Considering the special framework of IST of the European Commission, there are several projects since 2000 that have contributed to the state of the art and the applications. Among them and for their relevant contributions we would like to point out the LeGE-WG (The Learning Grid Excellence Working Group) which aim was to facilitate the establishment of a European learning Grid Infrastructure and the ELeGI (European Learning Grid Infrastructure) Integrated Project.

The future of the Grid technology applied to e-Learning and Technology Enhanced Learning solutions and applications is quite promising. The total implementation and use of these technologies will mean a great advantage for the teaching/learning process and a new era in the learning field. The way to go is still very long and the research in the field is wide open but it is foreseen that in the coming years we will start seeing and using these results in our daily life.

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State of the Art on Learning Grid

Technological Perspective

The purpose of this short article is to outline the most recent and significant works that contributed to the development of the vision of the Learning Grid. New technological trends are included in a further article.

1. Introduction

In the recent years, distributed Grid technologies have started to be very popular in education due to the advantages that Grid architecture offers being based on a secure, flexible and coordinated way of sharing resources in the Internet as well as on its enormous capabilities of information processing. This fact not only increased their demand but also generated new challenges in order to improve their functionality and decrease their limitations. For this reason, we proceed to outline the most recent and significant works that contributed to the development of technologies that make possible the vision of the Learning Grid.

2. Learning Grid Initiatives

The Grid Service Based Portal for Virtual Learning Campus [10] developed an environment which makes use of the Grid capabilities so that to make possible the dynamic sharing and coordination of heterogeneous resources which are found dispersed in the network. The project focuses on the development of a video digital library based on Grid for a Virtual Campus that allows an easy access and implementation of several services. In spite of being a project that aimed to take advantage of the capabilities that Grid technology provides, it is limited on a unique type of educative resources, like video, which a structure of services is developed for.

[9] describes a platform of e-learning based on Grid service technologies. In this platform the supply of virtual learning services designated for students, instructors and course suppliers is based on the resource administration for group collaboration based on Grid, allowing ubiquous access to information and taking advantage of the potentiality of the computer systems. On the one hand, the advantage of this proposal is that it is the first one that elaborates on the use of Grid resources and their description through Grid technologies, in particular WSDL. On the other hand, it dictates the need for the development of a semantic model description that enables a more complete description of learning resources.

ULabGrid, an Infrastructure to Develop Distant Laboratories for Undergrad Students over a Grid, [11] proposes a new architecture that allows the educators to design remote collaborative laboratories for university students using the Grid infrastructure. This project is one of the first in its type in trying to combine the facilities that Grid provides in a practical scenario in order to achieve resource sharing and motivate collaborative work. In this sense the design of Grid-based collaborative learning scenarios should be supported by semantic descriptions that allow the best tracking of resources available in the network.

Another work that aims at developing a Generic E-learning Engineering Framework Embracing the Semantic Web [17] proposes the convergence of e-learning, Web semantics and e-business by introducing a generic engineering approach that labels learning objects with RDF for semantic e-learning and integrating it with a process oriented paradigm. This work can serve as one of the first approaches as regards the use of information modeling and RDF to label learning scenarios resources, making use of a process management approach, which if adapted to the Learning Grid will provide a new generation of applications.

A further work proposes an Agent-Based Robust Collaborative Virtual Environment for E-Learning in the Service Grid [12]. In this virtual environment, all Web resources and services are accessed via service encapsulation, which may result in a more scalable and robust collaborative learning architecture. A very remarkable aspect of this work is the way it uses to implement complex services from more basic ones, though no use of semantic description is made to allow the automatic composition of complex services from lower level ones.

KGTutor, a Knowledge Grid Based Intelligent Tutoring System [13], proposes a model for the construction of intelligent tutoring in a more pleasant and effective way. The KGTutor is designed to provide better support to student centered distributed learning. Students' characteristics, such as previous knowledge and learning styles, are used to choose, organize, and deliver the learning materials to individual students. During learning progress, the system can also provide objective evaluations and customized suggestions for each student according to their learning performance. This system provides a very important work as far as student centered learning concerns, though it could be further strengthened through the use of aspects of semantic description of learning services.

KGCL, a Knowledge-Grid-Based Cooperative Learning Environment [14], supports the cooperation between a person and the computer at a knowledge level, and allows the enrichment not only of the resources in the Knowledge Grid but also of the users' knowledge by means of knowledge refinement, knowledge reuse and the online meeting of participants. The KGCL prototype has been currently applied and is available for online use. Experiments have shown that the environment can promote the effectiveness of group work. This system has also shown the great impact that Grid technologies can have even though no model of semantic description was implemented that could improve its performance.

In [18], a Grid Service Framework for Metadata Management in Self-e-Learning Networks focuses on how the use of metadata can be critical for Grid systems. More specifically, the semantic description constitutes a very beneficial extension of Grid environments. The Self e-Learning Network (Se-LeNe) is used as a test application while a set of services is proposed which are implemented with OGSA. The project focuses on providing services that use learning objects metadata, based on a sufficiently generic approach so that they can be used by other Grid-based systems which need to make use of semantic descriptions.

The Semantic Grid for human learning is one of the main objectives of the integrated project ELeGI (European Learning Grid Infrastructure) [7]. The objective of ELeGI is to provide an advance in the current practices of learning through the definition and implementation of a software architecture that achieves to unify the semantic Grid and information technologies in order to promote and give support to the definition and adoption of learning paradigms for the construction of knowledge that combines customized and ubiquous techniques based on experiential, collaborative and contextualized learning.

In this line, [16] presents a work about ontology based user modeling for personalization of Grid learning services. This work describes how the learning services of the semantic Grid should support a user-centered, customized, contextualized, experiential and ubiquous based learning approach. They claim that in order to provide a customized learning process, it is necessary to study and define methodologies that represent the context of learning and student through suitable knowledge structures, such as the ontologies. This work focuses then on the role that customized ontologies may play on a new generation of intelligent services; more specifically, it explores the role of ontologies to obtain Grid-based learning services in ELeGI.

The SELF project [6] proposes a learning environment that results from the integration of several technologies, specially the semantic Web, Grid technology, collaborative tools as well as customized tools and knowledge management techniques. SELF provides a mechanism for the intelligent search of services making use of semantic description tools. This project presents an important reference of the use of different technologies for the development of Grid-based learning scenarios, even though it is not based on semantic description models for the definition of its tools.

OntoEdu [3] is a flexible platform for online learning which is based on diverse technologies like ubiquous computing, ontology engineering, Web semantics and computational Grid. It is compound of five parts: user adaptation, automatic composition, educative ontologies, a module of services and a module of contents; among these parts the educative ontology is the main one. The main objectives of OntoEdu are to obtain reusability of concepts, adaptability for users and devices, automatic composition, as well as scalability in functionality and performance. In the near future, this platform aims to be adapted to a Grid environment so that it can carry out its activities based on distributed computing.

The work developed in [15] presents a workflow framework for pervasive learning objects composition by employing a Grid services flow language. The learning objects are distributed in heterogeneous environments which have been used in order to allow effective collaboration and the reuse of learning objects; this fact can help users to learn with no limitations of time and space. This work shows the great opportunities that exist in those research groups which make use of Grid technology to develop innovative, pervasive and ubiquous learning scenarios. Though this research work is still encountered at an initial phase, it can be further enhanced by the application of semantic description of learning services.

In the work described as "Extending and Augmenting Scientific Enquiry trough Pervasive Learning Environments" [8], the authors show the advantages of using pervasive learning scenarios that take advantage of mobile and wireless devices. This fact is used to integrate several scientific processes and provide support to students that carry out activities outside the class. This project has not yet implemented mechanisms for representing learning objects through semantic description.

Finally, in the work referenced as "Semantic Search of Learning Services in a Grid- Based Collaborative System" [4], the authors have constructed an ontological description for collaborative work tools that allow one to make a manual search of the diverse resources that these tools provide within a Grid environment with the minimum of technical knowledge. This work proposes a Grid-based tool called Gridcole, which can serve as a basis to implement different conceptual approaches of Grid-based semantic description of learning services, thus extending and endowing it with an innovative, pervasive and ubiquous projection.

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State of the Art on Learning Grid

Technological Trends

The purpose of this short paper is to overview the technological trends for both Service Oriented and Grid architectures as well as their exploitation in the Technology Enhanced Learning field.

1. New Trends in Service Oriented and Grid Architectures

The main relevant initiative in Europe concerning Service Oriented architectures and Grid infrastructure is the Networked European Software & Services Initiative (NESSI) EU Technology platform [1].

NESSI aims to provide a unified view for European research in Services Architectures and Software Infrastructures that will define technologies, strategies and deployment policies fostering new, open, industrial solutions and societal applications that enhance the safety, security and well-being of citizens [3]. NESSI ***is about transforming the EU economy through Service Oriented business models.***

In order to promote and make real the transformation, NESSI is defined in the context of a holistic approach to an ecosystem in which all the parties involved coexist and which can develop into a new economic model. This holistic model embraces the whole service area and, as depicted in the following picture, foresees NESSI as a key element in the EU economy.

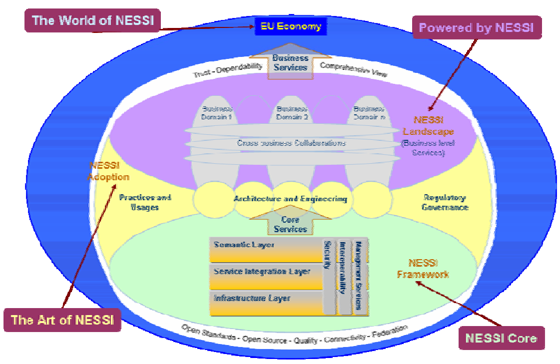

Figure 1- The NESSI Holistic View

The three main constituent parts of the NESSI context are:

– ICT Technologies, represented by the NESSI Framework, where the services, the key elements of the ecosystem, are engineered;

– The NESSI Landscape, where the services as implemented by the NESSI Framework are applied to specific businesses and domains, and for cross-domain cooperation;

– The set of instantiation mechanisms based on regulations, rules and policies which, constituting the NESSI Adoption, make services real and thus usable by the consumers.

The scientific and research debate about analysis and refinement of the NESSI Vision and the why to achieve it will happen inside the NESSI Working Groups [4]. There exist two kinds of NESSI WG: Horizontal, that address the key technological issues and Vertical, that will provide both requirements and help in instantiating the NESSI in specific domains. At the present are operating the following NESSI horizontal Working Groups:

– Service-Oriented Infrastructure NWG

– Service Engineering NWG

– Software Engineering NWG

– Business Process Engineering NWG

– Adaptive Interactions NWG

– Semantic Technologies NWG

– Trust, Security and Dependability NWG

– Services Sciences NWG

And one vertical Working Group on e-Health. It is under discussion the possibility to start a vertical WG on Learning.

One of the relevant aspects in terms of enabling infrastructure in the NESSI Framework is the **SOKU** vision, as elaborated by the Next Generation Grid (NGG) experts' panel [2]. This panel has defined the Service Oriented Knowledge Utility concept as:

– a flexible, powerful and cost-efficient way of building, operating and evolving ICT-intensive solutions for use by businesses, science and society;

– builds on existing industry practices, trends and emerging technologies;

– provides the rules and methods for combining services into an ecosystem that promotes collaboration and self-organisation;

– brings benefits of increased agility, lower overhead costs and broader availability of useful services for everybody, shifting the balance of power from traditional ICT players towards intermediaries and end consumers of ICT.

SOKU presents at the core of its vision the semantics and the service concept that, anyway, is slightly different for the service concept of traditional SOAs (e.g. Web Service or WS-Resources concept). In fact, in SOKU, the services:

– are semantically described, i.e. annotated with machine processable metadata which facilitates their automated use. This enables them to be dynamically composed and configured, and for them to adapt automatically, providing self-management and autonomic behaviour. A SOKU service may itself consist of collections of services which are statically or dynamically orchestrated;

– work with semantically described content and semantic descriptions, i.e. they process knowledge – they may contain and use it, consume it, or produce it. This leads to a more generic set of services which are configured to the task at hand using explicit representations of the appropriate vocabularies, schemas or ontologies.

As emphasised in [2], the SOKU vision technically builds on a natural evolution and combination of concepts from Web Services, Grid technologies, the Semantic Web, distributed analytics and self-organising systems that have reasonably broad international industry acceptance.

After this short overview, we can observe that in the future trend relies upon the service concept and on the exploitation of semantic and knowledge technologies. This, of course, have a good impact in supporting the Learning Grid vision that requires the flexibility and dynamicity of the service concept (to allow the creation of learning experiences using a compositional approach) and the semantic and knowledge technologies (in order to support the creation and the sharing of knowledge and semantic annotation of learning services and resources).

2. TEL Viewpoint

From a TEL point of view, currently the e-**Learning 2.0** is finding most interest from both academic and industrial communities. It is based on the Web 2.0 vision that refers to a second-generation of Internet services (social networking sites, wikis, communication tools, and folksonomies) that let people collaborate and share information online in previously unavailable ways [5]. O' Reilly in [6] clarifies the meaning of Web 2.0 and some technologies claiming to be "Web 2.0 compliant" are emerging.

With the Web 2.0 coming, educators and students take interest in blogs and pod-casts. Blogs are used for a wide variety of purposes in education like Group Discussion, Coordination Tool, Personal Reflective Journalism, Knowledge Management Tool for Learner Studies, E-portfolio, etc. (for students) Personal Knowledge Sharing, Instructional Tips for Students, Class Administration, etc. (for instructors).

Stephen Downes (National Research Council of Canada) was the first to understand the metamorphosis from e-learning 1.x (resource oriented, event-oriented and experience-oriented) to e-learning 2.0. Downes summarizes the transformation process with these phrases [7]:

[...] The e-learning application, therefore, begins to look very much like a blogging tool. [...] It becomes, not an institutional or corporate application, but a personal learning center, where content is reused and remixed according to the student's own needs and interests. It becomes, indeed, not a single application, but a collection of interoperating applications — an environment rather than a system.

It also begins to look like a personal portfolio tool. The idea here is that students will have their own personal place to create and showcase their own work. [...] "The portfolio can provide an opportunity to demonstrate one's ability to collect, organize, interpret and reflect on documents and sources of information. [...]

[...] Rather than being composed, organized and packaged, e-learning content is syndicated, much like a blog post or podcast. It is aggregated by students, using their own personal RSS reader or some similar application. [...]

Following the previous vision and the Scott Wilson's model [8] we present in the next figure the VLE of the future (called also Future VLE), compatible with the vision of e-learning 2.0 formulated by Downes, from three points of view (functional, theoretical and technological). More information about the technologies and tools for the future VLE can be found in [8].

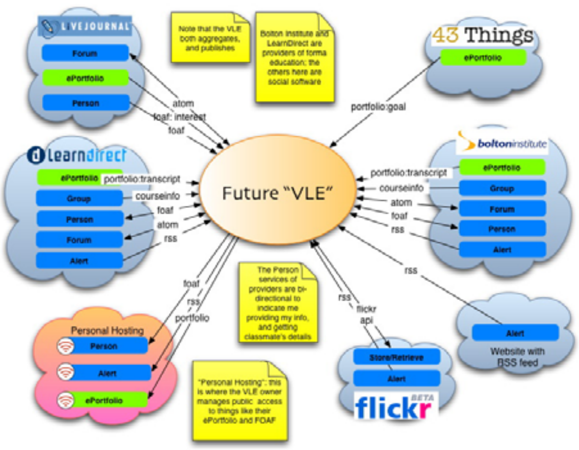

Figure 2- The Future VLE

Finally, to conclude our overview of e-Learning 2.0, we highlight that from theoretical point of view, e-learning 2.0 and the Future VLE follow the principles of connectivism theory of George Siemens: the starting point of connectivism is in fact the individual. Personal knowledge is comprised of a network, which feeds into organizations and institutions, which in turn feed back into the net-work, and then continue to provide learning to individual. This cycle of knowledge development (personal to network to organization) allows learners to remain current in their field through the connections they have formed. In this context Service Oriented Architecture and Grid and their evolutions seems to be the natural enabling infrastructure for allowing future learning scenarios.

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Angelo Gaeta and Pierluigi Ritrovato

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State of the Art on Learning Grid

Cognitive Perspective

This short article moves the focus from technology to pedagogy linked with the Learning Grid. It tries to show which kind of learning approaches are more suitable to be exploited in a Learning Grid environment in comparison to traditional e-Learning settings. Particular emphasis will be given to learning approaches based on orchestrated learning activities and on communication and cooperation processes.

1. Introduction

The dominant learning approach in Technology Enhanced Learning has been for many years the Information Transfer, based on the central figure of the teacher whose primary activity is the provisioning of educational contents to be transferred to learners that passively consume them. Consequently many e-Learning solutions provide a "digitized" version of this approach so, in most cases, distance learning platforms focus on educational resources and on their delivery.

This aspect, together with other relevant lacks, as the support for pedagogies, the contextualization of the learning experience and the centrality of the learner, lowers the effectiveness of the above learning solutions.

Nowadays, the need for e-learning systems supporting a rich set of pedagogical requirements has been identified as an issue of paramount importance. Several initiatives take place to meet this need. Maybe, the most important one is IMS Learning Design [1] that provides a framework to depict pedagogies allowing the design, the implementation and the deployment of learning experiences based on the selection and the orchestration of different learning activities.

In the next paragraph we will demonstrate why Learning Grid is particularly suitable for the implementation and the deployment of such kind of learning experiences. In a subsequent paragraph we will focus instead on a subset of pedagogical approaches based on communication and cooperation (C&C) processes seeing, also in this case, the added value of the Learning Grid.

2. Learning Grid and Learning Approaches based on Orchestrated Learning Activities

Grid seems to be the enabling technology for the deployment of complex learning processes based on knowledge, like the ones provided by Learning Design scenarios.

IMS-LD allows to model teaching and learning practices that go beyond simple traditional web-based educational contents delivery. In [2] it is emphasized how IMS-LD adopts a two levels approach to fulfil this task, modelling both

1. the learning activities, to be defined as interactions between a learner and an environment, having the objective to achieve a planned learning outcome;
2. the learning approaches, involving the selection and orchestration of the activities on the basis of the pedagogies ensuring, among other things, the reuse of their components.

As outlined also in [3], reuse and re-purposing is somewhat difficult to obtain by means of traditional technologies that are generally information oriented and URL based. The features of dynamicity and adaptivity of (service oriented) Grid technologies can be so exploited to provide actual benefits from the viewpoint of reuse and repurposing of learning activities. Indeed, to reuse learning activities in different contexts and to obtain different outcomes requires mechanisms for automatic discovery and binding of new suitable educational contents and services as well as self-adaptive mechanisms when deploying the learning activities composing a scenario, which are distinctive features of Grid.

Work that investigates advantages and drawbacks of the integration between IMS-LD and Grid are presented in [4], [5] and [6].

In [4] the authors propose and justify the adoption of IMS-LD for Computer Supported Collaborative Learning (CSCL), and the advantages of Grid technology to support CSCL. The main result of their work converges in a distributed system that can select and integrate Grid Services according to the prescriptions of IMS-LD documents. In [5], instead, the authors propose the Grid enabled Learning Object (GLOB) to allow the execution of learning activities exploiting mainly computational capabilities of a Grid.

Results presented in [6] allow learning activities to be bound to educational resources and services using semantic capabilities at learners' fruition time, in order to best fit their preferences and networked resources availability. They do not define a specific structure acting as interface to the Grid and, furthermore, they strongly rely on semantic enrichment of IMS-LD documents in order to retrieve at run time educational resources through the Grid.

The need of a Grid-based approach in the creation of learning scenarios based on the IMS-LD specifications can be supported, moreover, by the Service Orientation and the Virtualization paradigms that are at the basis of the OGSA model. They are clearly useful in a learning approach that strongly relies on a composition paradigm allowing the creation of personalized learning experiences (re-)using data, educational contents, knowledge and tools virtualized as services and distributed across different organizations.

In addition, with respect to the other Service Oriented Computing approaches, the Grid approach provides a well defined taxonomy [7] able to solve many issues connected to the creation and management of Virtual Organisations and, in accordance with this taxonomy, a set of capabilities have been already defined in the framework of the OGSA V1. This is a key factor in collaborative and community-based processes by supporting the dynamic creation of communities and their management. But this is deepened in the next paragraph.

2. Learning Grid and Didactic Methods Based on C&C Processes.

Learning approaches based on communication and cooperation (C&C) processes generally bring to the creation and execution of learning experiences in which collaboration and communication among participants play a key role. There are several didactic methods based on C&C processes such as:

– *Virtual Classroom* that simulates on-line the characteristics of a real classroom;
– *Synchronous Instant Communication* relying on several means of synchronous communication among the involved actors;
– *Problem-Based Learning* in which students are engaged in the resolution of a problem related to learning objectives;
– *Collaborative Apprenticeship* based on the prior observation of a given task;
– *Jigsaw method* where each student's part is essential for the completion and full understanding of the final product.

The Learning Grid is one of the best paradigms to be exploited in learning approaches based on C&C processes. It is not only useful to reach the desired level of dynamicity and scalability for a group or a community and to manage its heterogeneity but also for transparent ubiquitous resource sharing.

Through the virtualisation paradigm, traditional collaborative tools can be virtualised as services (both Grid or Web). This allows to add dynamicity since they can be provided on demand and it is possible to search and retrieve the most suitable tool on the basis of some parameters like, for instance, preferences of the group of learners and/or QoS.

Exploiting the distinctive features of the Grid services (mainly lifecycle management and statefulness, but also manageability) it is possible to increase scalability and support management of interactions respectively. It is possible to create more instances of services to support the collaboration.

Furthermore, the state management capabilities of Grid services allow to define and associate a state to each service (following the WSRF specification, the related stateful resource concept and implied resource pattern). This is an useful feature if we want to maintain trace of some data/information during cooperation and conversation among the learners.

As enabling technologies for Virtual Organisations (VO) for learning, Grid provides support for geographically distributed community creation and management, logically defined as VLC (Virtual Learning Communities) addressing issues like heterogeneity, Single Sign On, group and community lifecycle management, localisation and instantiation of tools and services, transparent resource sharing.

Dynamicity and adaptiveness of Grid technologies are key features in order to provide advanced mechanism for service discovery and instantiation on the basis of Service Level Agreements (SLA) documents and self-management, self-monitoring, etc. This allows, for instance, to deploy and execute a service on the most suitable host of a VO and to monitor at-run-time its SLA., control the resources access through policy based mechanisms, etc. By exploiting flexible and standard based mechanisms for transparent resources reservation, sharing and accessibility, Grid also improves ubiquity and accessibility.

Semantic Grid capabilities allow moreover semantic annotation of educational resources and services for automatic discovery, the late binding of educational resources and services in the learning environment, improving the capability to support learning community creation and management.

The usefulness of these capabilities for learning is also supported by several research papers proposed by different researchers among which we would like to mention the Editorial “Advances of the Semantic Web for e-learning: expanding learning frontiers” published on Vol 37 issue 3 May 2006 of British Journal of Educational Technology, where a Semantic Web / e-Learning research issue correspondence map is provided.

It is worth mentioning that in the case of creation of formal learning experiences based on the C&C approach, all the benefits that we have emphasised for the creation and execution of learning experiences based on other approaches apply as well.

In addition to what highlighted above, the following table summarises some needs of the C&C processes pointing out the benefits coming from the adoption of a Learning Grid with respect to traditional approaches.

Needs	Traditional approaches	Learning Grid added value
Resources/Document sharing	Adoption of a centralised shared workspaces systems (e.g. BSCW)	Exploitation of VO functionalities for resources sharing (including tools) and management. Semantic capabilities to allow automatic search and retrieve of resources matching user needs and preferences
Awareness of the group members	Traditional tools for collaboration generally provide information on the availability on-line of members of a group.	Enhanced presence allowing to search and find peers/tutors with specific profiles, with specific interests, etc. To this purpose semantic capabilities and ontologies (like the Learner profile ontology, extending the W3C FOAF)
Creation and management of collaborative sessions inside a group	Traditional systems provide low support for this feature. For instance, the session has to be scheduled, participants have to join, the documents and materials for the collaborative session have to be uploaded in a shared workspace, etc.	Grid technologies and the Grid service container concepts allow to improve the creation and management of collaborative session allowing a dynamic adding/removing of services, resources and participants in the collaborative session. Semantic capabilities allows for automatic discovery of services and resources matching the specific needs of the group and/or the collaboration session.
Integration of different heterogeneous tools	Currently, many functionalities for C&C are provided by different tools that are difficult to integrate together in order to create a environment supporting C&C	The virtualisation paradigm and SOA (e.g. OGSA) approach allow to simplify the integration issue. Different tools can be virtualised and managed as services. Furthermore, they can rely upon functionalities of the Grid middleware to improve.

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State of the Art on Learning Grid

Social and Cultural Perspectives

The purpose of this short article is to focus on social and cultural impacts of the Learning Grid trying to describe main changes that should be made in activities in schools, universities, workplaces and informal settings to support a Learning Grid

1. Technology and cultural change in education

The introduction of new technologies has always created cultural shifts in teaching and learning practice. For example, the move from chalk-and-board to pen-and-paper meant that learner's exercises and notes became permanent artefacts that can be referred back to at a later point in time, rather than a transient tool. Further changes in learning practice have since been brought about with the introduction of computers and networked information resources to the classroom: these technologies afford many new possibilities for learning activities and for access to and storage of information.

The advent of the Learning Grid creates further possibilities for change in the culture and landscape of learning. It is notoriously difficult to predict the full range of cultural change that any particular new technology will lead to: technologies are used in unforeseen ways (for example, the unexpected popularity of SMS messaging on mobile phones) and there can be unexpected consequences from their introduction (such as the rise in plagiarism created by "cut-and-paste" technology coupled with widespread access to the Web).

As the Learning Grid is at an early stage of development, it is not possible to say at the moment what its full cultural impact will be. However, it is clear that there are implications for learning across the board and that support for the widespread introduction of Learning Grid technology will require changes to learning activities in schools, universities, workplaces and informal settings. We explore some of the anticipated changes in the rest of this section.

2. Uptake and implications of Learning Grid technology

While new software technologies are what make construction of the Learning Grid possible, it will (initially at least) need to be built on the foundations of existing computer hardware. Therefore, differing levels of technological provision in schools, universities and workplaces across Europe will have an impact on the uptake of Learning Grid technology in different countries. A thorough review of existing technological provision is required in order to determine the implications of this basic economic factor.

A related issue is that of inclusion of learners in Learning Grid environments: there are large numbers of people who fail to access traditional routes to learning for a variety of social and economic reasons, and the Learning Grid must make sure it provides an opportunity to include currently disenfranchised groups by reducing barriers to their participation.

The introduction of the Learning Grid will have far-reaching implications for all areas of education and beyond. It will require new perspectives on the nature of teaching and learning, and new business models and processes to be developed:

- The role of the teacher will change (but certainly not disappear!), based on changing student needs. There will be a further shift towards process-driven rather than content-driven teaching, and teachers and instructors may more often be one of a partnership of a variety of people involved in the educational process, rather than being the key deliverer. One aspect of this changing role will be in educating learners to be able to make the most effective use of the technology available to them.
- There are implications for the awarding of qualifications and more generally for the assessment of attainment. The Bologna agreement already provides the basis for curriculum harmonisation for university degrees across Europe, but further agreement about the constitution of qualifications at all levels and credit transfer between institutions will be necessary as the Learning Grid opens up new progression routes for diverse populations of learners.
- New business models will need to be developed in order to define the new relationships between Grid participants: learners, teachers, service providers and content providers need to find ways of working together on the Grid.

In our view, it is also important that the Learning Grid technologies developed should allow the greatest heterogeneity of language and culture possible, guarding against the homogenisation and cultural atrophy that could be a real danger when disparate populations plug in to the same learning resource. Sophisticated personalisation technology is one way to address this issue, and so the development of interoperable learner models and ontologies for learner modelling that reflect the needs of the diverse population of learners across the whole range of learning contexts must be a priority for development.

3. Hints at cultural change in recent activities

The Learning Grid has the potential to make a huge impact on lifelong learning and workforce development. The **Lifelong Learning in London for All** (L4All) project [1], and the recently announced Linking London Lifelong Learning Network (L4N) led by Birkbeck are focussed on supporting lifelong learners. The system developed in L4All allows learners to record and share learning pathways though educational offerings, facilitating progression from secondary education, through to Further and Higher Education.

L4All is also investigating the integration of its services with e-portfolio tools. Whereas currently e-portfolios are generally tied to a particular institution or course of study, in the age of the Learning Grid it is essential that such portfolios will be interoperable across the entire range of learning services. E-portfolios will gain much greater importance as the main record of an individual's experience, training and expertise as learners engage more with personal development planning and create individual learning pathways, rather than following the prescribed routes of more traditional career development.

The creation of the Learning Grid will be an evolutionary process, as there is a move from today's closed departmental and enterprise Grids to more open Grid environments. As systems become more complex and offer an increasing range of services, the learning curve for users to be able to take full advantage of the system becomes steeper. This increasing system complexity places an onus on system developers to create new ways to interact with and access advanced learning services. One possibility in this direction (planned to be investigated at Birkbeck) is the use of a game-based application as interface to accessing the personal development planning services provided by the L4All system.

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News form the SIG Workshop “Next Generation in Technology Enhanced Learning”

This article briefly report on the joint workshop between ELeGI and Kaleidoscope Learning Grid SIG that was held the last 24th October in the venue of eChallenges Conference in Barcelona.

About twenty-five participants had taken part to the workshop, some of them presented their own work. After the welcome and an overview on the two involved projects, the authors presented their work, involving the other participants in interesting discussions.

The contributors to this workshop have been selected from Integrated Projects of different domains. It is planned to organise a series of similar workshops in the future as it is expected that the convergence of Virtual Learning Organizations (VLO) models is not likely to happen in short term and regular exchange of ideas and the feedback from delegates with a business context is highly desirable.

Anna Pierri from the University of Salerno presented an application of the Virtual Scientific Experiment (VSE) Model in different learning scenarios: the Masters course in ICT, which involves three academic institutions, namely Athens Information Technology-Greece, Carnegie-Mellon University-PA-USA and Cylab-Japan, as well as the Physics Courses at the Hellenic Open University. As part of the former, a VSE for Wireless Sensor Networks (SENSASIM) was specified and deployed while the latter, involved the specification and design of a collaborative VSE for Physics experiments.

The contribution of **Pierluigi Ritrovato** from CRMPA has shown how to exploit models and services of the ELeGI software architecture in order to create and deliver adaptive (to context, learner’s preferences, didactic methods, etc.) and dynamic Units of Learning (UoL), according to the VSE model defined in the project. A concrete case of study related to a physics course has been analyzed to show the benefits provided by Semantics and Grid. According to the VSE model, the steps to create, publish an execute a UoL have been presented, focusing the attention on the personalization process and on the extension made to the IMS-LD language and tools

Santi Caballè from Open University of Catalonia presented the importance of the efficient representation and management of the event information generated from group activity in online collaborative learning practices in order to provide awareness about individual and group behaviour. So, for this purpose a conceptual model of collaborative learning interaction was taken into account in order to classify the information generated in an online collaborative learning situation at several levels. The model was tested through the construction of a specific application, a structured forum, used in real situations.

Alexandra Poulovassilis from the Birkbeck University of London presented the L4All (Life-Long Learning in London for All) project. L4All is a pilot system that records and shares learning pathways through educational offerings with the aim of facilitating progression of lifelong learners from Secondary Education. The system allows learners to access information and resources registered with the system by their providers, to plan their own learning pathways, and to maintain and reflect on their learning throughout life. The system allows learners to share their learning plans and pathways with other learners in order to encourage collaborative learning.

The contribution of **Pascal Dugenie** from LIRMM was illustrated by Antonio Paradell. He presented the use of Grid Shared Desktop (GSD) in the context of scientific collaboration in order to show how a collaborative environment can foster the collaborative modelling of shared knowledge in the form of ontology. One frequent goal of human collaboration is to define a common corpus of knowledge about a domain of expertise; when formalised and computerised, this knowledge representation artefact is known as an ontology. The GSD may provide an engaging environment for helping users to formalise and capture knowledge that is initially informal and distributed in the minds and documents of several people, into a shared ontology.

Presented papers are available in the conference proceedings “Exploiting the Knowledge Economy: Issues, Applications and Case Studies”, Vol. 3, Information and Communication Technologies and the Knowledge Economy, P. Cunningham and M. Cunningham eds., IOSPress.

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News

Benchmarking Access and Use of ICT in European Schools 2006

September 2006

More than 2/3 of the EU's schools benefit from high-speed internet. Surfing the Web as well as virtual communication and training methods are becoming more and more a daily experience in Europe's school. A European Commission survey out on 29 September shows that most European schools now have the high-speed "broadband" internet connections they need to access speedily high-quality content. However, there are still important variations from Member States.

"Europe is starting to reap the benefits of broadband at schools, where the foundations are laid for a knowledge-based society" said Information Society and Media Commissioner Viviane Reding. "I congratulate those EU countries which, on the basis of an efficient implementation of EU rules, have promoted competition in broadband services and infrastructures and thereby are now also generating encouraging results for their education systems. Broadband internet access can become one of the most efficient drivers for both economic and social competitiveness".

Read More at:
http://europa.eu.int/information_society/newsroom/cf/itemlongdetail.cfm?item_id=2888.

EGEE becomes world largest scientific Grid

October 2006

The EU funded project "enabling Grids for e-science" (EGEE) is processing more than 30,000 computing jobs a day making it the world's largest scientific Grid infrastructure. Launched in 2004, EGEE infrastructure involves 91 institutional partners in 32 countries across Europe, Asia, and USA, and is linked by Europe's GEANT2 high-speed communications network and similar networks around the world.

Computing tasks are carried out by scientists from diverse fields of research, and range from simulations of molecular docking for neglected diseases to geophysical analysis of oil and gas fields. Clusters of hundreds and even thousands of computers are put to work to perform calculations, using in total over 25,000 central processor units (CPUs) and several million gigabytes of data storage in disk and tape facilities.

The EGEE has recently been made interoperable with other national and international science Grids like the Open Science Grid in the US ands NAREGI in Japan. The project partners say that this latest development is in keeping with the original vision to establish a common Grid infrastructure for computer sharing similar to what the World Wide Web did for information sharing.

In addition to scientific applications, the EGEE team is also seeking to extend the infrastructure's services to industry. So far three companies have signed up as the first EGEE Business Associates (EBAs) to work with the project to make the distributed computing infrastructure of the Grid more user-friendly, effective and secure in an industrial context.

Read more at: http://www.eu-egee.org/.

IBM Makes Linux and Grid Easier

November 2006

IBM has unveiled new service offerings to help ease adoption of Linux and grid computing technologies. Big Blue said its new Implementation Services for Linux and Grid and Grow Express Implementation are based on a new IBM Research-designed automated Web-based tool that can significantly reduce implementation time and expense.

For Linux implementations, IBM said its new Implementation Services for Linux Service Product helps clients quickly implement Novell SUSE Linux or Red Hat Enterprise Linux. For grid implementations, Big Blue said its new Grid and Grow Express Implementation Service Product includes hardware, software and services and can be incorporated into current storage and server infrastructures. Middleware is selected by industry application to ensure that the solution is architected for a particular industry.

The new service products are the latest in IBM's strategy to deliver traditional labor-based technology services in the same way as technology products. "These new Linux and grid service products will enable organizations to take advantage of emerging technology benefits like strong security, high reliability, better flexibility and lower cost of ownership" Tom Ready, vice president of IBM Server Services, said.

Source: Grid Computing Planet

Read More at:
www.ibm.com/services/spotlight.

When	What	Where
Dec 3-6, 2006	**The 23rd annual conference of the Australasian Society for Computers in Learning in Tertiary Education** In conjunction with the 1st International LAMS conference. The focus of the LAMS conference is on designing for the future. Where will Learning Design take us now? How is LAMS shaping up? What are the challenges for individuals and organisations? Importantly they want to capture the experience of those who have used LAMS and share some of the lessons learnt in higher education, the K-12 sector, vocational and professional education. http://www.ascilite.org.au/conferences/sydney06	**Sydney, Australia**
Dec 4-6, 2006	**The 4th European Conference on Web Services (ECOWS 2006)** The European Conference on Web Services (ECOWS) is the premier conference for both researchers and practitioners to exchange the latest advances in the state of the art and practices of Web Services. http://www.ifi.unizh.ch/ecows06/	**Zurich, Switzerland**
Dec 4-7, 2006	**The 4th International Conference on Service-Oriented Computing (ICSOC'06)** The 4th International Conference of Service Oriented Computing (ICSOC'06) follows on the success of three previous editions in Amsterdam (2005), New York City (2004), and Trento (2003). Today ICSOC is recognized as the main conference for service oriented computing research and covers the entire spectrum from theoretical and foundational results to empirical evaluations as well as practical and industrial experiences. http://www.icsoc.org/	**Chicago, USA**
Dec 18, 2006	**International Workshop on Semantics in Virtual Organizations and Web Services** In conjunction with the 2006 IEEE/WIC/ACM International Conference on Web Intelligence (WI'06). Virtual organizations and Web services have caught enormous research efforts over the last few years and become a new research field. It has been increasingly recognized that semantic issues and semantic description frameworks play an essential and crucial role in the semantic Grid and the semantic Web. Focusing on the research and applications in the fields of virtual organizations (the semantic Grid) and Web services, this workshop is intended to provide researchers an idea-exchange forum for their initial studies and practices in semantic and conceptual modelling based approaches to VO and WS constructions and development. http://www.dur.ac.uk/w.w.song/SVO&WS2006-main.html	**Hong Kong, China**

When	What	Where
Dec 18-21, 2006	**13th International Conference on High Performance Computing (HiPC 2006)** The 13th annual IEEE International Conference on High Performance Computing will serve as a forum to present the current work by researchers from around the world, and act as a venue to provide stimulating discussions and highlight high performance computing (HPC) activities in Asia. HiPC 2006 will focus on all aspects of high performance computing and networking systems and their scientific, engineering, and commercial applications. In addition to technical sessions consisting of contributed papers, the conference will include invited keynotes from leading HPC researchers, a poster session, tutorials on hot topics in computing/networking, an industry session with vendor presentations, HPC exhibition and user community meeting, and workshops on emerging areas and cutting edge topics. www.hipc.org	**Bangalore, India**
Dec 27-30, 2006	**International Conference on Distributed Computing and Networking, ICDCN 2006** International Conference on Distributed Computing and Networking, ICDCN 2006, formerly known as IWDC (International Workshop on Distributed Computing), will be held in the Indian Institute of Technology. Over the years, IWDC has become a premier forum for disseminating the latest research results in distributed computing and networks. In keeping with the growing number of papers in the area of networking in the recent IWDCs, the workshop has been renamed as ICDCN from 2006. www.iitg.ac.in/icdcn2006/main.htm	**Guwahati, India**
Jan 29 – Feb 2, 2007	**The 19th Open Grid Forum - OGF19** OGF19 will feature 5 days of interesting and engaging content on grid computing including Enterprise and eScience workshops, Standards group sessions and BoFs, Requirements and standards alignment sessions, Keynote presentations and plenary sessions, Networking and social activities. Included in the workshop program are two full day sessions that feature timely topics on grids and eScience: Web 2.0 and Grids and Federated Identity and Grids. www.ogf.org/OGF19/events_ogf19.php	**Chapel Hill, North Carolina, USA**
Jan 31 – Feb 1, 2007	**Learning Technologies 2007 Conference** The Learning Technologies conference, now in its eighth year, is widely regarded as Europe's foremost thought-leadership forum on organisational learning. The conference attracts many of the world's renowned learning experts, leading industry figures, more than 40 speakers and over 200 delegates. The 2007 conference theme is 'Learning for organisational performance' and will focus on the technologies and methods available to both organisations and individuals to maximise performance at work through learning and development. Information on the Learning Technologies 2007 Conference programme, sessions and speakers will be available from November 2006. http://www.learningtechnologies.co.uk/conference/conference.cfm	**Olympia 2, London**

When	What	Where
Feb 13-15, 2007	**The IASTED International Conference on Parallel and Distributed Computing and Networks (PDCN 2007)** This conference will act as an international forum for researchers and practitioners interested in the advances in and applications of parallel and distributed computing and networks. It will be an opportunity to present and observe the latest research, results, and ideas in these areas. All papers submitted to this conference will be peer evaluated by at least two reviewers. Acceptance will be based primarily on originality and contribution. www.iasted.org/conferences/home-551.html	**Innsbruck, Austria**
Mar 23-30, 2007	**Workshop on Large-Scale and Volatile Desktop Grids (PCGrid 2007)** The workshop on Large-Scale, Volatile Desktop Grids will be held in conjunction with the IEEE International Parallel & Distributed Processing Symposium (IPDPS). Desktop grids utilize the free resources available in Intranet and Internet environments for supporting large-scale computation and storage. The purpose of the workshop is to provide a forum for discussing recent advances and identifying open issues for the development of scalable, fault-tolerant, and secure desktop grid systems. http://pcgrid07.lri.fr	**Long Beach, CA, USA**
Mar 26, 2007	**Fourth High-Performance Grid Computing Workshop** Computational grids allow the federation of significant computational and storage resources to solve challenging problems in science, engineering, medicine, finance, and entertainment. Involvement of multi-core platforms and wireless communications in the traditional grids comprised of clusters, workstations, and supercomputers pose new challenges to manage the grids and open new opportunities in using them. The High Performance Grid Computing workshop provides a forum for presenting research results on most aspects of grid computing, with a focus on performance, in the following areas: Applications, Benchmarking, Infrastructure, Management and Scheduling, Partitioning and Load Balancing, and Programming Models. www.cs.unb.ca/profs/aubanel/hpgc/	**Long Beach, CA, USA**
Mar 26-30, 2007	**21st IEEE International Parallel & Distributed Processing Symposium (IPDPS 2007)** IPDPS serves as a forum for engineers and scientists from around the world to present their latest research findings in the fields of parallel processing and distributed computing. The five-day program will follow the usual format of contributed papers, invited speakers, panels, and commercial participation mid week, framed by workshops held on the first and last days; this year in Long Beach that will be Monday and Friday. www.ipdps.org/	**Long Beach, CA, USA**