Learning GRID

A newsletter form the Kaleidoscope Learning GRID SIG **Chief Editor: Nicola Capuano**

Newsletter #5: July 2005

Deliverable D 12.2.7

Prepared for the European Commission under Contract No. NoE IST-507838 as a deliverable from

Task: 12.2: Networking and Dissemination
Date of issue: 31/07/2005
Version: 1.0
Distribution: public

In this Issue:

Editorial

Welcome to the fifth issue of the Kaleidoscope Learning GRID SIG newsletter. This issue appears right after the Kaleidoscope Symposium that took place from July 6 to 8 in Oberhausen, Germany. Therefore, it is a good opportunity to report about this symposium from a Learning GRID SIG point of view.

The agenda for our SIG looked as follows:

- Learning GRID Vision by Silvio Stefanucci, Centre for Research in Pure and Applied Mathematics, Italy.
- Activities of the Kaleidoscope Learning GRID SIG
  by Giovanna Albano, University of Salerno, Italy.
- Scenarios for a Learning GRID by Agathe Merceron, Engineering School Leonard de Vinci, France.
- Enabling Technologies for a Learning GRID by Silvio Stefanucci, Centre for Research in Pure and Applied Mathematics, Italy.
- Pedagogical Models for a Learning GRID by Giovanna Albano, University of Salerno, Italy.

All these talks (many of them given by Nicola Capuano due to last minute changes) present the Learning GRID vision and the technologies to support this vision.

The SIG vision is to contribute to the achievement of an improvement in European (e-) learning practices, with the definition of open, distributed and pervasive environments for effective human learning, where learning is a social activity consumed in dynamic virtual communities based on communications and collaborations, and where learners, through direct experiences, create and share their knowledge in a contextualized and personalized way. The Semantic Grid for Human Learning is the technology proposed in this SIG to enable such a vision.

SGHL is a combination of Grid, semantics and learning design. Grid technology provides a transparent access to distributed (stateful) services and resources, interoperability between heterogeneous environments, security, trust and ubiquity. Semantics makes it possible to provide services typical of the learning domain and thus allows for resources discovery, service composition and personalisation. Learning Design allows for creating scenarios able to capture all the identified pedagogical features.

Let me to conclude with a personal thought. I took part in the workshops of the Virtual Doctoral School and of the Shared Virtual Laboratory. I think that we have things to share with these two entities. Sten Ludvingsen and Katharina Scheiter presented their experiences in running courses for students of the Virtual Doctoral School. The scenario a collaborative research environment (Newsletter issue 2) is quite close to the ideal kind of support that course managers would like to offer to VDL students. SVL is moving towards a service approach; technologies discussed in our SIG might be useful.

Agathe Merceron

Learning Grid SIG Steering Committee Member

Service orientation in the Learning GRID SIG

The goal of this article is to initiate a survey on services as currently defined in the various projects and experiments of the teams belonging to the Kaleidoscope Learning Grid SIG.

Introduction

Service orientation in the Learning GRID takes numerous forms and, despite our effort in the Kaleidoscope Learning Grid SIG, is far from being understood. We informally introduce what it is meant by service in section 1. We survey in the following sections services described or suggested in a number of recent projects such as Diogene, Selene, ActiveMath, LevinQam, as well as some other sets of services extracted from various e-learning scenarios published in the 4 first issues of the learning Grid newsletter or suggested during the 1st International Kaleidoscope Learning GRID Special Interest Group Workshop on Distributed e-Learning Environments, Napoli, 14th March 2005. This review of services is far from exhaustive. It only has for a target to illustrate the diversity of services among partners, from most learning-independent and most generic to most learning scenario-specific. Other criteria of interest which should be taken into account in a future classification should include grid or P2P services versus more centralized services, data intensive versus computing services, stateless versus stateful services, etc.

What is a service?

Unfortunately there is no agreement on a simple definition/model for services.

A service is invoked by a end user, or another service which is not necessarily located on the same site. It has a goal: it gives as an output some result, it accesses some distributed and heterogeneous resources, performs a series of operations by interacting with these resources. It can be a combination of other services. A user on site s can invoke a service on site s' which execution in turn is decomposed in a series of services located on sites, s", t, v, etc. A service can be executed where it is located or be replicated to be executed on the user site.

A discussion about service orientation and their definition in the context of the Learning GRID can be found in [MRD04]. The authors classify services in stateless services (pure functions) and stateful, dynamic, conversational services, whose execution depends on a state. [G04,G04-1,G04-2] are good introductions to the service technologies in a grid context including Web services, OGSA and WSRF.

Diogene

The project Diogene [CGIO05] offers ITC training using ITC intensive methodologies. Entities in Diogene offer and consume services and are fully distributed. All services are described using the WSDL standard. The services registry uses UDDI. One finds 3 categories of services:

1. **Common Services**. This includes services to search and retrieve LOs (Learning Objects) in repositories. To this aim, LOs are indexed with meta-data following the IMS Metadata 1.2.2 standard. Such services are domain independent. (They could use a Data GRID if repositories become too big.) Entities offering such services are called Publishing Houses. It includes also administration services allowing different kinds of users to register and authenticate themselves; payment and hiring services, etc.
2. **Knowledge Domain Services** to describe pedagogical information about the didactic domain offered by the system. To this aim, domain concepts (that learners can study and acquire as skills) are described as an ontology with three relations: Has_Part, Requires and Suggested Order. The Diogene ontology describes the computer science domain. It contains 1652 concepts from the ACM computing classification system.
3. **Advanced Services**: services to automatically build groups of similar learners and to provide learners with a list of other learners with similar interests and profiles. To this aim, Diogene indexes each learner with a student model. A student model is composed of a Cognitive State and a set of Learning Preferences. Groups of learners are built according to a distance which is calculated using the student model. Similarly, a list of learners with similar interests and profiles is provided to a learner putting in the list the closest students according to a distance defined between student models.
4. **Services to search and retrieve LOs on the Web** which are not indexed by meta-data, Diogene uses the ontology concept as well as keywords extracted from the textual description. Then, the system performs a search with Google. For LOs that are indexed with another ontology, the system performs

a mapping between the concepts of the two ontologies. This mapping between concepts (relations are not taken into account) is based on similarities between textual descriptions attached to concepts.

5. **Automatic Course Generation Services**. A student willing to study concepts makes a request using concepts of the ontology. The system, generates automatically a course using the ontology, the student model as well as services to retrieve LOs (both from Diogene repositories and from the web). Diogene manages a pool of tutors. A tutor is indexed by a model similar to the cognitive state of learners. Thus Diogene is not only able to generate automatically a course, but also a training program with tutors to coach learners.

Selene

The SeleNe project [KPP+05] (self e-learning networks, http://www.dcs.BBK.ac.uk/selene) has a semantic web view of LOs. The semantics of LOs is described through metadata. SeleNe does not manage the LOs themselves but their metadata descriptions. It provides only common services for the discovery, sharing and collaborative creation of LOs. LO's descriptions are represented in the Resource Description Framework (RDF, RDFS). Four types of services are noteworthy:

1. Registration services are the first category of services in SeleNe: LO authors register new LOs created either from externally created LOs (atomic LOs) or composite objects created from already registered LOs. Changes in LO's description may be automatically detected and notified.
2. Declarative queries and Views belong to another class of services. RQL is used for querying metadata and the RVL language provide views of LOs reflecting an instructor's view of a domain of interest.
3. Ranking LO's descriptions according to the relevance to the user is another service provided by the project.
4. The last class of services is related to Event and change notification and is based on a language called RDFTL, an Event detector and a Condition evaluator.

In summary, SeLeNe provides a general view of LOs independent of the LOs structure and of the functions internal to the LO. The semantics of LOs is not only described by metadata that conform to e-learning standards such as IEEE/LOM but can also employ taxonomies of specific learning environments as well as domain specific taxonomies (among which ACM/CCS is an example).

ACTIVEMATH

In contrast to DIOGENE and SeLeNe, ACTIVEMATH services [LW05] are dedicated to a specific learning objective and learner model. The learner model and the estimated knowledge of the learner is maintained by tracking its activity and actions.

The management of the content database and the learner knowledge is one functionality. Another one is the so-called mathematical system's service. All the components are deployed as Web-services taking into account the state of the component and managing events and notifications and higher level tools based on these web services taking into account the state of a web-service, providing client access to web-services, interactive exercises with computer algebra systems, etc.

ACTIVEMATH provides an automatic course generation similar to that of Diogene, but without the tutor part.

LeVinQam

The LeVinQam project [DMS05] as well distinguishes services general enough to be shared by a community with a specific e-learning objective. In contrast to ACTIVEMATH, there is no learner model but as for ACTIVEMATH, interactive exercises are specific LOs also called reactive LOs [DMSW0505] with a state.

The learning domain is programming languages. Calls to a programming language API or interpreter or compiler and response analysis on pieces of code returned by the learner are identified as services to be shared by a community of e-learning environments and or users.

As for ACTIVEMATH, LeVinQam strongly relies on the systematic tracking and storing of learner actions and errors and performance on the set of exercises he/she performed. The data mining of the stored indicators is one of the objectives of the LeVinQam learning platform. Then it is foreseen to declare and render available as Web services all data mining facilities and statistical tools used for such a data mining process.

LeVinQam has also as an objective to give a service orientation to the coloured Petri-net functionality developed in the prototype for specifying and playing very general learning guided tours [DMRS04].

Learning design and distributed e-learning

[CGIO05] proposes an extension of IMS-LD for modeling domain independent pedagogies. In IMS-LD services are generic functions such as e-mail, conferencing, searching and announcements. Learning or support activities are executed in specific environments formed by LOs and services provided during execution and bound to the learning design scenario.

[CGIO05] uses IMS learning resource metadata (IMS-MD) specification. It defines units of learning (UoL) as sequences of LOs enriched with services assembled by a teacher to explain some concept. UoL delivery services gather a large class of services such as: retrieving concepts within the UoL, invoking the localization service, performing queries, binding activities and real LOs, playing of the UoL, etc.

Miscellaneous

Among other services in e-learning environments suggested by scenarios in the newsletter issues, one can list locating available teachers, discussing with experts selected by teachers, accessing dedicated services such as profitability simulator in a scenario on how to elaborate a business plan (issue #3, sixth scenario) or calling a Java compiler in a programming language e-learning project.

[RO05] distinguishes virtual learning communities between basic services (notification, resource e-management, metering accounting and Billing) and core services (sharing of new knowledge, collaborative work).

References

[DMRS04] P. Duval, A.Merceron and M. Scholl, LeVin-Quam: a question answering mining platform, Proc. of ITHET04, Istanbul, June 04, IEEE Press, pp. 250-255

[G04] A. Gaeta, Web services, Newsletter from the Kaleidoscope Learning Grid SIG, issue #1, July 2004

[G04-01] A. Gaeta, OGSA, Newsletter from the Kaleidoscope Learning Grid SIG, issue #1, July 2004

[G04-02] A. Gaeta, Web Service Resource Framework, Newsletter from the Kaleidoscope Learning Grid SIG, issue #2, Ocotober 2004

[MRD04] D. Mac Randal and T. Dimitrikatos, A vision about the learning grid, Newsletter from the Kaleidoscope Learning Grid SIG, issue #2, October 2004

[CCC05] N. Capuano, M. Gaeta, R. Iannone and F. Orciuoli, A Virtual organisation for e-learning, 1st International Kaleidoscope Learning GRID Special Interest Group Workshop on Distributed e-Learning Environments, Napoli, March05

[CGIO05] N. Capuano, P. Carrolagi, J. Combas, F. Crestani, M. Gaeta, E. Herber, E. Sangineto, K. Stefanov and M. Vergara, Learning Design and run-time resource binding in a distributed e-learning environment, 1st International Kaleidoscope Learning GRID Special Interest Group Workshop on Distributed e-Learning Environments, Napoli, March05

[DMS05] P. Duval, A. Merceron and M. Scholl, Reactive Learning Objects for Distributed e-learning environments, 1st International Kaleidoscope Learning GRID Special Interest Group Workshop on Distributed e-Learning Environments, Napoli, March05

[DMSW05] P. Duval, A. Merceron, M. Scholl and L. Wargon, Empowering learning objects: an experiment with the Ganesha Platform, Proceedings of Ed-media 2005, July05.

[KPP+05] K. Keenoy et al, Adaptative Personalisation in Self e-learning Networks, 1st International Kaleidoscope Learning GRID Special Interest Group Workshop on Distributed e-Learning Environments, Napoli, 3/05

[LW05] P. Libbrecht and S. Winterstein, The service Architecture in the ACTIVEMATH learning Environment, 1st International Kaleidoscope Learning GRID Special Interest Group Workshop on Distributed e-Learning Environments, Napoli, March05

[RO05] N. Romano, Virtual Learning Communitites, Newsletter from the Kaleidoscope Learning Grid SIG, issue #3, January 2005

Patrick Duval,
Agathe Merceron,
Michel Scholl

ESILV/GI, PULV, Paris la Défense

Research Project Focus: SeLeNe

The Self e-Learning Networks project (SeLeNe) was an EU FP5 Accompanying Measure that ran from 1st November 2002 to 31st January 2004. It was a feasibility study into the use of Semantic Web technologies to support learning communities, matching learners' needs with the educational resources potentially available on the Web. SeLeNe proposed several novel learning services, including collaborative creation and semi-automatic description of learning resources, the ability to create personal views over an RDF repository, personalised event and change notification services and the automatic generation of trails of Learning Objects from their descriptions. Some of these services have been implemented in prototype software and are currently been evaluated as part of follow-on research at the London Knowledge Lab, ICS-FORTH and LRI-Paris Sud.

What is a Self e-Learning Network?

A Self e-Learning Network (SeLeNe) consists of web-based Learning Objects (LOs) that have been made available to the network by its users, along with metadata descriptions of these LOs and of the network's users. The SeLeNe does not manage the learning resources themselves – it instead facilitates access to them by managing their metadata descriptions. The community of users (learners, instructors and content providers) who comprise the SeLeNe create the metadata repository by registering LOs with the network.

LO metadata descriptions, along with the schemas that these conform to, form SeLeNe's *LO information space*. In order to enable effective search for LOs in a SeLeNe, LO descriptions conform to e-learning standards such as IEEE/LOM (Learning Object Metadata), and also employ topic-specific taxonomies of scientific domains such as ACM/CCS (Computing Classification System) or taxonomies of detailed learning objectives. LO schemas and descriptions are represented in the Resource Description Framework/Schema Language (RDF/S), which offers advanced modelling primitives for the SeLeNe information space. Users can search the LO information space in order to locate LOs of interest to them, and can also define personalised views over this potentially large number of learning resources, to show only the information and resources that they are interested in personally. Users can also subscribe to personal notifications of events in the network, for example, a user might wish to be notified when a new LO on a topic they are interested in is registered, or when a new member with similar interests joins the SeLeNe.

One of the first tasks of the project was to investigate the desirable user requirements for such a system, and to define the functionality of the system based on these requirements. Readers are referred to [1] for the full functional specification.

There are several deployment options for a SeLeNe. In the most general case each SeLeNe will consist of a number of *peers* that interact with one another across a network (this could be a local network, the Internet, or a Grid infrastructure). Each of these peers will support some subset of the full set of SeLeNe services.

Figure 1 shows the general peer-to-peer architecture, and Figure 2 shows the service architecture of a SeLeNe.

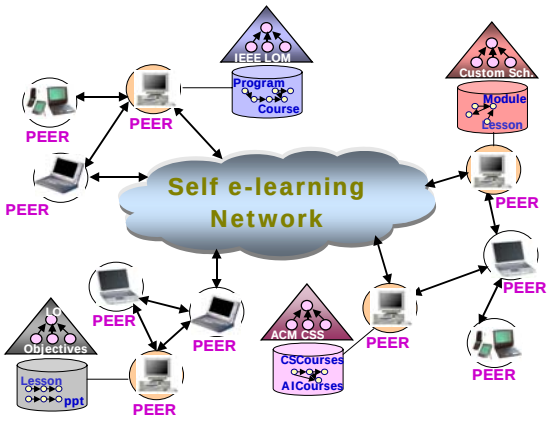

Figure 1: A Self e-Learning Network

Registration of Learning Objects

An important learning service in SeLeNe is the LO Registration service, which supports collaborative creation and semi-automatic description of LOs. As we have seen, SeLeNe does not manage individual LOs, and the LOs made available to the network are not necessarily hosted by the individual members of the SeLeNe (although they may be). This means that registration of a LO simply consists of submitting a metadata description, including the URI of the LO, to the SeLeNe system.

LO authors maintain control of the content they create and can use any tools they wish to create their LOs before registering them. We call such

LOs, created externally to SeLeNe, *atomic LOs*. *Composite LOs* that have been created as assemblies of LOs already registered with the SeLeNe can also be registered. To assist the metadata creation process the SeLeNe can automatically derive taxonomical descriptions for composite LOs from the taxonomical descriptions of their constituent LOs.

The final taxonomical description used to register a composite LO *o* is derived from two sets of terms: a set of terms supplied by the LO's provider (which can be empty), called the publisher taxonomical description (PTD), is augmented with an automatically generated set of terms called the implied taxonomical description (ITD) of *o*. The ITD is derived from the taxonomical descriptions of its component LOs $o_1,\ldots,o_n$, and 'summarises' the taxonomical descriptions of the parts of *o*.

The ITD of a composite LO *o* expresses what its parts have in common – only terms reflecting the content of all parts are included in the ITD. Inclusion of an LO o_1 as part of a composite LO *o* may thus lead to the generation of different ITDs for *o* depending on what the 'companion' parts to o_1 are within *o*.

The ITD of a composite LO *o* composed of parts $o_1,\ldots,o_n$ with descriptions $D_1,\ldots,D_n$ is computed by a simple algorithm that takes the Cartesian product of $D_1,\ldots,D_n$, computes the least upper bound of each n-tuple and then 'reduces' the resulting set of terms by removing all but the minimal terms according to the subsumption relation between the terms of the taxonomy. The overall taxonomical description of a LO *o* is computed by another simple algorithm: if *o* is atomic then its taxonomical description is just its PTD. Otherwise its taxonomical description is recursively computed from its PTD and the taxonomical descriptions of its constituent parts. Readers are referred to [2] for more details of both algorithms.

Personalised Views

Users of a SeLeNe can search for LOs of interest to them using a keyword-based query interface that will rely on the RQL query language for RDF "under the hood". As well as searching the entire repository for LOs users will be able to define personalised views of the LO information space in order to browse or search for only those LOs (and those metadata attributes) of interest to them. For example, a learner might want LOs presented according to his/her educational level and current course of study.

This enhancement of the user's experience through personalisation of the way the information space is viewed can be achieved using the RVL language [3]. RVL can provide simpler virtual schemas that reflect an instructor's or learner's perception of the domain of interest by offering techniques for the reconciliation and integration of heterogeneous metadata describing LOs, and for the definition of personalised views over a SeLeNe information space.

One of the most significant features of RVL is its ability to create virtual schemas by simply populating the two core RDF/S metaclasses *Class* and *Property*. A SeLeNe user can then easily formulate RQL queries on the view itself. View definition in SeLeNe is discussed in detail in [4].

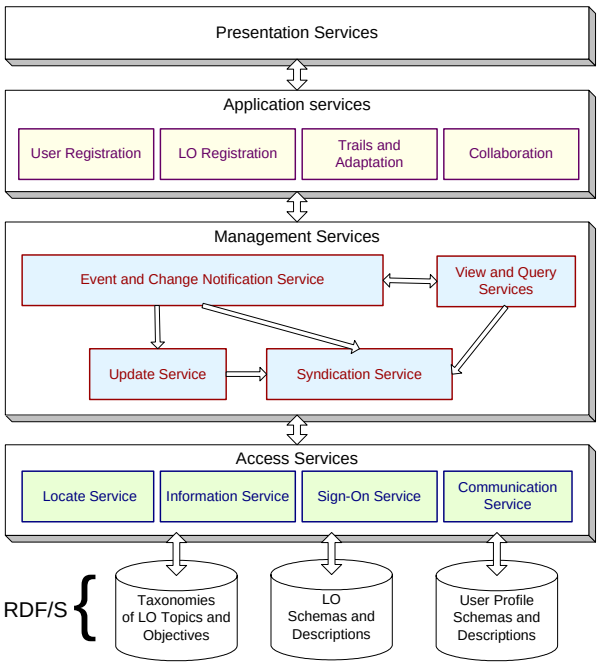

Figure 2: SeLeNe's service architecture

Personalisation and Trails

The search results returned to users when they search a SeLeNe will be personalised – the results returned to a particular user will depend on information stored in their user profile as well as on the search terms they submit.

The user profile is an RDF description of the user that consists of some elements from existing profile schemas (PAPI Learner and IMS-LIP), some of our own elements (we have defined RDFS schemas for expressing competencies, learning goals and learning styles), and a history of user activity that will allow the profile to adapt over time, automatically updating the information therein by means of a generic set of Event-Condition-Action rules (see later) associated

with all SeLeNe profiles. The learner also has a *messages* property with a *Notifications* class as its target. This is to store personal notifications (of new users and new or updated LOs) for the user. Figure 3 shows a simplified version of SeLeNe's personal profile schema.

Search results will be personalised by *filtering* and *ranking* the LOs returned according to the information contained in the user's personal profile. (The underlying query mechanism in SeLeNe is RQL, but users will mostly search for LOs using simple keyword-based queries, with corresponding RQL queries being automatically generated behind the scenes.) The personalisation is performed by the Trails and Adaptation service, which constructs personalised RQL queries for execution and generates personalised rankings of query results by matching the personal profile against relevant parts of the LO descriptions.

Users will also have the option of having their query results presented as a list of *trails* of LOs, where a trail is a suggested sequence of interaction with the LOs. These trails will be automatically derived from information contained in the LO descriptions about the semantic relationships between LOs. In the SeLeNe project we defined an RDF representation of trails as a sub-class of the RDF *Sequence* (a sequence of LOs) with two associated properties, *name* and *annotation*, that provide additional information about the pedagogic use of the trail. In subsequent work, as part of the Kaleidoscope Trails project [5], we have developed a richer metadata schema for learning trails that expands the enumeration of possible types of trail and additionally includes (optional) timing information, topic, level, and other information enabling more complex learning design [6].

For more details of the RDF schemas developed, personalisation and trails in the SeLeNe project see [7].

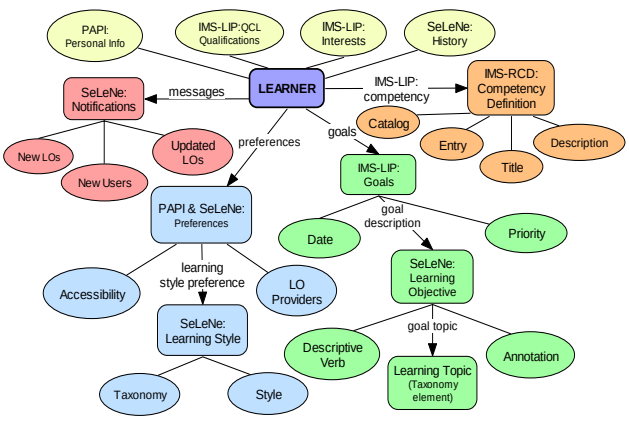

Figure 3: SeLeNe's user profile

Event and Change Notification

SeLeNe provides a range of reactive functionality that includes:

- automatic updating and maintenance of the user profile;
- propagating changes in the taxonomical description of a LO to those of any composite LOs depending on it;
- propagating changes in a learner's history of accesses of LOs to the learner's personal profile;
- notifying users of the registration of new LOs of interest to them;
- notifying users of changes in the description of resources of interest to them.

This reactive functionality is provided by means of Event-Condition-Action (ECA) rules over SeLeNe's RDF/S metadata, which act in a similar way to triggers in a relational database. These ECA rules will be automatically generated by the higher-level Presentation and Application services of the SeLeNe architecture. An ECA rule generated at one site of the network might be triggered, evaluated, and executed at different sites. Within the event, condition and action parts of ECA rules there might or might not be references to specific RDF resources, i.e. ECA rules may be resource-specific or generic.

We refer the reader to [8] for a detailed description of the syntax and semantics of RDFTL, our language for specifying ECA rules on RDF.

Those peers in a SeLeNe that support the Event and Change Notification service will run an *ECA Engine*. Such 'superpeer' servers may coordinate a group of further 'peer' servers (as well as themselves playing the role of a 'peer').

The ECA engine at a superpeer consists of several subcomponents:

- The *RDFTL Language Interpreter* takes an RDFTL rule definition as input and registers it in a Rule Base. The Language Interpreter consists of a *Parser* and a *Translator*.
- The *Event Detector* detects the occurrence of events within a local RDF/S repository and the triggering of rules registered within the local rule base.
- The *Condition Evaluator* determines which of the triggered rules should fire.
- If a triggered rule's condition evaluates to true, the *Action Scheduler* generates from the action part of the rule a set of updates to

be sent for execution to the appropriate local peers and other superpeers.

- The *Routing Service* maintains information about the superpeer's immediate neighbours in the network and the message transmission pathways between them.

Our current implementation uses RDFSuite as the repository and RDFTL path expressions are translated into RQL by the Language Interpreter.

Our recent paper at the 1st International Kaleidoscope Learning GRID Special Interest Group Workshop on Distributed e-Learning Environments contains worked examples of ECA rules, as well as further details on all the topics covered in this article [9].

Final Remarks

This article has described several novel techniques for providing the personalisation services of Self e-Learning Networks. We are currently finishing the implementation of some of these services, and we then plan to deploy and evaluate them within a Grid/peer-to-peer architectural framework. In particular, the current implementation of Event and Change Notification services exploits the JXTA peer-to- peer framework in order to deliver active functionality in a distributed peer-to-peer environment over RDF e-learning metadata repositories.

References

[1] K. Keenoy, G. Papamarkos, A. Poulovassilis, M. Levene, D. Peterson, P. T. Wood, and G. Loizou, *Self e-Learning Networks: Functionality, User Requirements and Exploitation Scenarios.* SeLeNe Technical Report, 2003. http://www.dcs.bbk.ac.uk/selene/reports/Del22.pdf.

[2] P. *Rigaux* and N. Spyratos, *Generation and syndication of learning object metadata*. SeLeNe Technical Report, 2004. http://www.dcs.bbk.ac.uk/selene/reports/Del4.1-2.2.pdf.

[3] A. Magkanaraki, V. Tannen, V. Christophides, and D. Plexousakis, *Viewing the semantic web through RVL lenses*. In Proceedings of the Second International Semantic Web Conference (ISWC'03), Sanibel Island, Florida, USA, October 2003.

[4] A. Magkanaraki, V. Christophides, G. Karvounarakis and D. Plexousakis, *Views and Structured Querying in Self e-Learning Networks*. SeLeNe Technical Report, 2003. http://www.dcs.bbk.ac.uk/selene/reports/Del4.3-2.0.pdf.

[5] Trails JEIRP, http://www.dcs.bbk.ac.uk/trails.

[6] J. Schoonenboom, A. Lejeune, J-P. David, M. Turcsányi-Szabó, P. Kaszás, L. Montandon, A. Jones, K. Keenoy, and M. Levene. *Visualising trails as a means for fostering reflection*. Trails technical report, 2004. http://www.dcs.bbk.ac.uk/trails/docs/D22-02-02-F.pdf.

[7] K. Keenoy, M. Levene and D. Peterson, *Personalisation and Trails in Self e-Learning Networks*. SeLeNe Technical Report, 2003. http://www.dcs.bbk.ac.uk/selene/reports/Del4.2-2.1.pdf.

[8] G. Papamarkos, A. Poulovassilis, and P. T. Wood, *RDFTL: An Event-Condition-Action language for RDF*. In Proceedingds of the Third International Workshop on Web Dynamics, 2004. www.dcs.bbk.ac.uk/webDyn3.

[9] K. Keenoy, A. Poulovassilis, V. Christophides, P. Rigaux, G. Papamarkos, A. Magkanaraki, M. Stratakis, N. *Spyratos* and P. T. Wood, *Adaptive Personalisation in Self e-Learning Networks*. In Proceedings of the First International Kaleidoscope Learning GRID Special Interest Group Workshop on Distributed e-Learning Environments, Napoli, March 14, 2005. http://www.dcs.bbk.ac.uk/~kevin/docs/selene-kalsigGRID-FINAL.pdf

Kevin Keenoy

Birkbeck College
University of London, UK

Technology Watch

This section presents Technologies, Specifications and Standards related to the e-Learning and GRID world. A brief description will be given together with a set of references to "must read" articles and documents.

IMS-Learning Design: Architectures and Tools

IMS-LD general overview

IMS Learning Design (IMS-LD) [1] is a complex, semantically rich and flexible specification used to model learning scenarios. A learning design is a description of the specific ordered learning and support activities to be performed by the specific actors involved in a specific learning experience in order to attain a specific learning goal, and represents an instance of a pedagogical model (e.g. Problem-based Learning, Competence-based Learning, etc.). A learning design is to be managed by instructors and educators in an easy-to-use way and presented to learners online. More important, the resulting learning scenarios are to be reused, shared and personalised for different learning purposes according to specific pedagogical requirements (e.g. using the same learning design with different resources).

In order to achieve these goals, IMS-LD provides a high-level XML-aware language or notation to formally describe units of learning (UoL) which are abstract representations of a course, lesson, workshop, or any other formal or informal learning or teaching event and includes a learning design and its connected resources. Therefore, due to its genericity, an abstract UoL is fully reusable and can be used for different learners and instructors, with different learning designs and materials, in different learning settings, at different locations and times and by different tools.

Once a UoL has been instantiated for a specific learning purpose and has been populated with the appropriate roles, materials, activities and so on, it is run by a IMS-LD software player so as to interpret the XML notation of the UoL's learning design as learners work through it (i.e. at run time) This is analogous to marking-up learning materials in HTML and having a browser interpret them.

As such, the IMS-LD notation enables the potential to create generic pedagogical templates by providing a formal description of the approach, roles and resources needed for a particular pedagogical need. This overcomes the complexities and tediousness in the preparation of a specific learning course *ad hoc* by instructors and facilitates its realisation by learners. Moreover, by evolving from the traditional content-based to activity-based learning provides new benefits for learning in terms of performance, outcomes, learners' motivation and engagement, social constructivism, collaboration, and so on.

Need for implementations

As a result of the huge variety of pedagogical requirements, courses, learning materials and activities, roles, and so on described by IMS-LD, it is not easy to provide tooling support for its high-level abstract specifications. Moreover, IMS-LD 1.0 specifications were released in early 2003 and there are currently no implementations to fully support these specifications. On the other hand, IMS-LD offers the potential in promoting the exchange and reutilisation of formulated and validated learning designs. The lack of full implementations, though, makes hard to explore this potential and predict its actual feasibility. To this end, some important efforts at providing architectures and implementing a number of tools and systems have been carried out.

Architectures and frameworks

Before describing the current efforts at implementing tools and systems for supporting IMS-LD specifications, it is worth looking at the larger picture in which they sit. Two LD related architectures have been developed, one for the authoring and one for the runtime environment [2].

- The **Learning Design Authoring Architecture** was developed by the Valkengburg Group with the view to describing the interfaces and dependencies between the functional components of a LD reference implementation for flexible authoring and content management tools. This architecture suggests the need for separating learning design editors, materials editors and metadata editors so as to make independent the learning activities from the learning design which can, thus, be reused with other activities for a different pedagogical purpose.
- CETIS' Bill Olivier proposed a **Learning Design Runtime Architecture** that shows the com-ponents and interfaces needed to both set up the activities and resources making up the learning experience and support live learning sessions. Although this architecture is considered as work-in-progress it could

provide support to implement LD runtime software (e.g. LD players).

- The **e-Learning Framework** (ELF) [3] is itself very relevant to IMS-LD in order to support Service-based Learning Design (SLeD). The ELF is an initiative by JISC (UK), DEST (Australia), and others to build a common approach to Service Oriented Architectures (SOA) for education. The ELF is the result of a shared conviction that ex-posing networked functions such as user and group data or learning content as simple ser-vices rather than as features locked up inside monolithic systems offers institutions more flexibility, more scope for pedagogic innovation and better return on present and future investment.

Tools and systems

In this section we take a brief look at the main implementations and open projects arisen to support the large abstract specifications of the IMS-LD and other IMS specifications. These implementations are to realise the architectures seen, mainly both as authoring tools to describe and edit the learning process by the IMS-LD notation and to run the models achieved by an IMS-LD-aware player. A player may be a stand-alone tool or it may be part of a Virtual Learning Environment (VLE).

- **Alfanet** [4] is an European Comission funded project under the 5th Framework Programme and aims to provide adaptive and personalised educational services to learners by constructing user models to support the most relevant tasks, such as adaptive presentation and navigation, collaboration and intelligent class monitoring. Alfanet provides an **IMS-LD Author** tool that supports the definition of courses based on instructional design and an **IMS-QTI Author** tool that facilitates the definition of dynamic adaptive assessments. It also includes both an **IMS-LD Engine** (CopperCore) providing adaptive learning on the basis of instructional design and learner user model, and the **IMS-QTI Engine** component providing adaptive self-assessment.
- **CopperCore** [5] is a J2EE runtime engine supporting all three levels of IMS Learning Design (A, B and C) [1], the first of its kind. This open source package is designed to be integrated into a range of existing e-Learning infrastructures. From a pedagogical point of view, the EU Alfanet project sponsored CopperCore engine functions like an invisible online classroom assistant. CopperCore is intended to be integrated in the JISC-ELF framework so as to support SLeD.
- The **RELOAD** [6] is a project funded under the JISC Exchange for Learning Programme that is producing an open source XML authoring framework and authoring tools for e-Learning specifications. Among other tools, this system provides both a **Learning Design Editor** and a **Learning Design Player** that are based on the IMS-LD specifications. The former allows the user to create templates to define a set of learning objectives, activities and learning environments. These templates can be repurposed with the user's own content to create on-line Learning Design compliant resources. From version 2.0, the editor provides full support for LD Levels B and C. Regarding the latter, it allows the user to *play* a UoL so that s/he may pick any of the roles and work through the sequence of plays, acts, activities and environments. Last version enables designers to preview their work without setting up a run of the UoL.
- The recently GPL-licensed **LAMS** [7] open-source software implements many of the concepts and ideas of LD and adds a number of its own. The consequence is that it is not an implementation of the IMS-LD specification and it cannot import or export IMS-LD compliant units of learning. The main features of Lams are its easy-to-use authoring tools which make it usable by teachers without a technical background. It is an integrated system with a run time engine, good monitoring and administrative capabilities.
- **Eduplone** [8] is a Learning-Content Management system that supports individualised content by selecting and adapting content to individual needs. Learning content is tagged with *didactical* metadata thus making the Learning Management Systems (LMS) aware of the *didactical functions* inherent in the materials. With this information, the LMS can then resequence and reorganize learning materials and assignments at runtime according to the individual needs of each learner.
- **eLive LD-Suite**® [9] is a commercial implementation that supports the design, documentation and optimisation of learning scenarios, including e-Learning and blended learning designs, and also supports scenarios focusing exclusively on conventional face to face settings.
- **The Komposer Suite**® [10] is a commercial IMS Content Package (IMS-CP) authoring tool using MS Word as the simple au-

thoring environment. At the moment, the tool handles only CP elements. LD elements will be added in the next version. Its architecture allows for the future possibility of LD editing with only minor modification.

- The **Service Based Learning Design System** (SBLDS) [11] project aims at creating Web-service interfaces and a sample service-consumer for the Coppercore LD Engine. This project provides a SLeD player as a JSP web-application which plays content provided by the Coppercore runtime engine. In the context of SLeD, Coppercore provides the player with content and activities based on the learning design being employed and user responses. The SLeD project contributed to fitting the engine with Web-service interfaces.
- A new set of emergent systems, including powerful editors such as **Chronotech LD Editor**, **ASK LDT**, **COSMOS** full editor Level B, GUI-based **MOT+**, and the **CASLO** collaborative authoring tool among others are under development. These systems [12] show how multiple approaches can be adopted to authoring with LD, which may be appropriate for particular groups of teachers and for different educational contexts. These applications are intended for learning designers, rather than teachers, but for many people they may be easier to comprehend.

References

[1] A general introduction of IMS LD is found at: http://www.cetis.ac.uk/lib/media/WhatIsLD_web.pdf

[2] Diagrams of the Valkenburg LD Authoring and the LD Runtime architectures can be found at: http://www.jisc.ac.uk/uploaded_documents/Learning_Design_State_of_Play.pdf.

[3] An e-Learning Framework. Paper prepared on behalf of DEST, JISC-CETIS, and Industry Canada: www.jisc.ac.uk/uploaded_documents/Altilab04-ELF.pdf

[4] Public deliverables of Alfanet project can be found at: http://rtd.softwareag.es/alfanet/

[5] Coppercore's web site: http://coppercore.org/

[6] The Reusable e-Learning Object Authoring & Delivery (RELOAD) project summary is found at: http://www.reload.ac.uk/summary.html

[7] The Learning Activity Management System (LAMS) web site: http://www.lamsinternational.com/

[8] Eduplone's web site: http://eduplone.net/

[9] The Elive Suite's web page: http://www.elive-ld.com/content/e56/e61/index_eng.html

[10] The GTK Press's Komposer Suite's web page: http://www.gtkpress.com/default.aspx?pid=m_1005

[11] The Service Based Learning Design System (SBLDS) project web site can be found at: http://www.elframework.org/projects/sled

[12] More information about the current LD tools can be found at the UNFOLD's web site: http://www.unfold-project.net:8085/UNFOLD/general_resources_folder/tools/currenttools

Santi Caballe
Thanasis Daradoumis

Open University of Catalonia

News

By Angelo Gaeta

5th Workshop on Grid and Peer-to-Peer Middleware for Cooperative Learning Environments

15-17 June 2005

This event was organised in Barcelona and was the fifth of a series of semester workshops that are taking place within the project "CRAC: Grid and P2P middleware for CSCL applications", financed by the Spanish Ministry of Science and Technology. This series follows a tradition of small scale workshops within several national projects in which specific research teams from University of Valladolid (UVA), Polytechnic University of Catalonia (UPC), and Open University of Catalonia (UOC) have been collaborating.

Its participants include researchers (professors, doctoral or senior undergraduate students) from all teams. Although the majority of participants come from technological departments (Computer or Telecommunications Engineering), there are also researchers from education departments (ICT in education), as well as invited researchers from several European Universities coming from Kaleidoscope teams that give a multidisciplinary and international character to the workshop.

A special characteristic is the open nature of the workshop, promoting the critical but constructive attitudes, either internal or external to the project. Participants are invited to keep their presentations short enough, in order to give more time for discussion within the sessions, with special emphasis to the panel and parallel sessions.

The workshop schedule was designed in order to provide a continuous interaction among the participants. In general terms the first day, besides a general introduction, focuses on Grid middleware for (collaborative) learning, while the second one focuses on P2P architectures, as well as general CSCL issues. The last day aims to provide for work in small groups, as well as for general conclusions, discussion and future actions.

In the current Workshop, several interesting topics were explored and covered, for instance, Interaction analysis, Modelling, scripting, design patterns and IMS-LD in CSCL, ontologies and search, CSCL Applications Focused on Knowledge Management Using Grid Infrastructure, a grid-based tailorable system for guided collaborative learning, semantic discovery of learning services in grid-based collaborative systems, on demand work environment based in grid for virtual projects, grid and e-learning: the vision of eLegi, among others.

The presentations as well as comments on the session are available at:
http://cvu.rediris.es/pub/bscw.cgi/0/598450

GGF 14 – Grids for Education and Outreach

28 June 2005

This session presented four talks addressing using Grids to enhance education. Randy Ruchti has discussed QuarkNet which is a collaboration between Fermilab and the particle physics Grid activities (open Science Grid) to use the Grid to bring the excitement of physics research to schools. This example of Grids in support of STEM (Science, Technology, Engineering and Mathematics) is built on by Bill Frascella who was director of ESIE (Elementary Secondary and Informal Education) component of EHR at NSF. Frascella has returned to Indiana University where he founded the Indiana Mathematics Initiative for middle schools. He explained how Grids can help bring resources such as virtual laboratories and science expertise to schools across the nation. The third talk comes from Al Kuslikis of AIHEC (American Indian Higher Education Consortium) who has described how Grids can help integrate Tribal Homelands into a broad community and in particular how e-Science is important for the Tribal Colleges. The final talk by James Turner of Virginia Tech has described the importance of Grids in developing technology, technologists and scientists in Africa. The initial effort is built around the netork of institutes forming the African Institute for Mathematical Sciences (AIMS)

The presentations as well as comments on the session are available at:
http://www.ggf.org/GGF14/GGF14Education.html

Alchemi - .NET Grid Computing Framework – V1.0 beta available

Jul 6, 2005

Alchemi is an open source software framework that allows you to painlessly aggregate the computing power of networked machines into a virtual supercomputer (**computational grid**) and to develop applications to run on the grid.

It has been designed with the primary goal of being easy to use without sacrificing power and flexibility.

Alchemi includes:

- The runtime machinery (Windows executables) to construct computational grids.
- A .NET API and tools to develop .NET grid applications and grid-enable legacy applications.

For more information:
http://www.alchemi.net/1_0_0_beta.html

IMS, ADL and IEEE LTSC will collaborate to update and standardize Content Packaging

8 July 2005

During working sessions at alt-i-lab 2005 in Sheffield, UK, representatives of the ADL Co-Lab in Alexandria, Virginia; the Learning Technology Standards Committee of the IEEE, and the IMS Global Learning Consortium outlined the collaborative approach the three organizations will follow to update the IMS Content Packaging specification. The updated specification will be accredited as an IEEE standard and the profile of the Content Packaging specification included as a key component of SCORM 2004, which will be revised to comply with the resulting standard.

"The IMS project that is already underway will update the current release of Content Packaging and develop solutions and corrections in response to adopted best practice in SCORM and elsewhere" said Colin Smythe, Chief Specification Strategist for IMS Global Learning Consortium. Smythe described the process by which the Content Packaging is being updated as "one which will bring representatives from the ADL and other IMS members together with experts from the LTSC. Robby Robson, chair of the IEEE Learning Technology Standards Committee (IEEE LTSC) stated that "we intend for the outcome of the IMS project to be a candidate standard that can be submitted immediately for adoption as an IEEE standard, subject to approval by an IEEE Ballot Group. It is anticipated that this approach will be used to minimize the delay in adopting other appropriate de facto learning technology standards as accredited IEEE standards." Kerry Blinco, chair of the IEEE LTSC CMI working group added that "our direct participation in the IMS project will help maintain consistency as Content Packaging moves from specification through the standardization process and into use in the field."

Paul Jesukiewicz, Director of the Advanced Distributed Learning (ADL) Co-Laboratory emphasized that "the overall goal of this collaborative process is to ensure that the de facto standards from which important components of SCORM 2004 are derived become internationally accredited standards. That status will help to reassure vendors and buyers of learning technology that they can rely on SCORM as a stable reference point on which to base acquisition decisions and product development plans."

The updated IMS specification is scheduled for completion by December 2005. IEEE balloting should be complete within four to six months of that date. Once the standard has been formally released SCORM 2004 will be revised as necessary.

For more information:
http://www.imsglobal.org/pressreleases/pr050708.cfm

IMS Releases ePortfolio Specfication

12 Jul 2005

IMS Global Learning Consortium (IMS/GLC) announced today the release of version 1.0 of its ePortfolio Specification.

This specification

- Makes moving portfolios from school to work easier.
- Allows institutions to better track learner competencies.
- Supports the use of ePortfolios for career development
- Makes accessibility preferences more available.

Darren Cambridge, ePortfolio project group co-lead stated, "By enabling learners to share their ePortfolios as integrated semantic wholes, the Specification dramatically expands the power of ePortfolios to enhance learning throughout life. Widespread adoption of the specification also is likely to lead to increased innovation in ePortfolio technology and practice."

"ePortfolios can become a powerful tool for tracking, planning, and sharing what one knows and can do throughout one's life," says Andy Heath, ePortfolio project group co-lead. "To realize this potential benefit, portfolios must be truly

portable. Widespread adoption of the ePortfolio specification will ensure this portability."

The final version of the ePortfolio specification, consisting of technical and narrative documents and accompanying examples and schemas, are available to the public at no charge from the IMS/GLC website.

For more information:
http://www.imsglobal.org/ep/index.html

The JISC e-Framework – Announcing details of international collaboration through e-Framework

12 Jul 2005

The e-Framework for Education and Research is a visionary new initiative that brings together and builds on the successes of a number of JISC development programmes – including the JISC Information Environment activity (IE), e-Learning Framework (ELF) and the Virtual Research Environment Programme.

The goal of the e-Framework initiative is to develop a service-orientated approach to the development and integration of computer systems in the sphere of teaching, learning, research and administration. In addition the e-Framework programme will support the vision outlined in the DfES e-strategy towards 'a common digital infrastructure to support transformation and reform'.

Increasingly standards are international in scope and therefore JISC cannot work alone; working under a collaboration agreement with the Australian **Department for Education, Science and Training** (DEST), JISC is leading this international initiative which it is hoped will attract support from other partners

For more information about this news: http://www.jisc.ac.uk/index.cfm?name=e_framework_news_120705

For more information about the JISC e-Framework: http://www.e-framework.org/

Middlebury helps advance adoption of learning technology standards

22 Jul 2005

Middlebury College is helping to advance the adoption of learning technology standards by releasing tools that allow developers to create applications that can be easily integrated into common educational environments, particularly those of small liberal arts colleges. Applications built with these tools should also make it easier for colleges to share learning content and technologies.

These tools include PHP bindings of the Open Knowledge Initiative (O.K.I.) Open Service Interface Definitions (OSID). OSIDs are open software specifications enabling applications to integrate with diverse service environments using a plug-in model that reduces development and custom integration costs. These bindings and example implementations are accessible via Middlebury's Harmoni application framework, which uses a Model-View-Controller (MVC) architecture to facilitate the rapid development of PHP applications.

For more information: www.okiproject.org

When	What	Where
September, 11 – 14, 2005	**The Second Grid Resource Management Workshop 2005** in conjunction with the SIXTH INTERNATIONAL CONFERENCE ON PARALLEL PROCESSING AND APPLIED MATHEMATICS The first GRMW took place in Poznan in October 2003, during the 10th Anniversary of PSNC. The second workshop will be organized in parallel with the PPAM 2005 conference to be held in Poznan, September 11-14, 2005. The workshop is organized in coordination with the European CoreGRID project. The main goal of the workshop is to provide a forum to researchers working on Grid scheduling and resource management where they could share with each other the methods, algorithms and architectures for grid scheduling. GRMW'2005 will gather researchers working on aspects such as: Grid scheduling architecture; Brokering mechanisms; Grid service management; Accounting; Economy grids; Resource discovery and monitoring; Policy management; Job and resource description languages; Scheduling and mapping algorithms; Heuristics and metaheuristics; Workflow execution and management; Data and network scheduling. For more information: http://ppam.pcz.pl/.	**Poznan, Poland**
September, 22 - 23, 2005	**Workshop about Learning Design - A Joint PROLEARN and UNFOLD Initiative** The workshop aims to provide an overview of current work in the field. Main topics are: • Development of LD tools and architectures, eg, editors, content management systems, runtime engines. • Advanced applications of LD (eg, in gaming, collaborative learning, competence development, ePortfolios) • Research and technology development to support users in creating an adequate learning design (e.g. software agents or design aids) • Research to evaluate the ability of the LD specification to integrate the following criteria: completeness, pedagogical flexibility, personalization, re usability, formalization, etc. • Evaluations of the use of LD in practice, including the integration of a variety of specifications in a learning environment • Studies defining the current state-of-the-art in learning design, or positioning LD in the wider context of learning, training and instruction For more information: http://www.prolearn-project.org/news/n0000118.html	**Heerlen, The Netherlands**

When	What	Where
September, 25 - 30, 2005	**International Conference on GRID Networks and Services** Internet, Grid (next-Internet) and coming architectural solutions represent logical steps, towards sharing resources and coordinated services in a secure, dynamic and flexible manner among individuals, institutions and other entities. With respect to Internet, Grid brings new solutions for computing and networking. Although some of the technologies that fueled Grids began in the open source community including clustering technologies and P2P file sharing, a new management paradigm shift is dictated by partially and intermittent available services in such largely distributed and fully shared environments. The evolution of using and managing partial and intermittent services will have an influence on how autonomic computing and anticiparallelism paradigms will be used, as well as on managing paradigms offered by policy-enabled and reflexive middleware concepts. While some mechanisms and technologies exist, many other Grid-tailored ones must be invented and/or proved. IBM, Sun, Intel, HP and Microsoft, among others, have been funding research and development around GRID technologies, autonomic computing and anticiparalelism. Equipment vendors (Cisco Systems, Inc., etc.) and OSS producers (Lucent Technologies, Telcordia, etc.) initiated supporting solutions to keep the pace with these early achievements focusing on GRID networking and GRID management challenges. ICGNS 2005 initiates a series of conferences with some distinctive characteristics, starting with considering GRID services, GRID middleware, GRID networking, and decisional GRIDS views as complements towards large scale GRID implementation. Logistically, it is intended to exchange on research, advanced, and practical industrial implementations, cross layers. For more information: http://www.iaria.org/conferences/ICGNS/ICGNS2005/GeneralInformation/GeneralInformation.html	**Sillicon Valey, USA**
September, 28 – 30 2005	**International Conference ICL** This interdisciplinary conference aims to focus on the exchange of relevant trends and research results as well as the presentation of practical experiences gained while developing and testing elements of interactive computer aided learning. Therefore pilot projects, applications and products will also be welcome. Among Keynote speakers there are: Erik Duval (K.U. Leuven and President of the ARIADNE Foundation), Paul Lefrere (Executive Director E-learning Microsoft Europe, Middle East and Africa), Pat Manson (Head of Unit Technology Enhanced Learning, European Commission), Steve Rae (Vice President IBM Learning Solutions), Michelle Selinger (Education Strategy Manager, Cisco Systems, Europe, Middle East and Africa), Sam Steinhardt (Executive Director, Center for Innovations in Learning, Stanford University). Topics of interest are: Web based Learning (WBL); Computer based learning (CBL); Computer aided language learning (CALL); Telelearning/ Teleteaching/Teletutoring; Life long learning; Mobile learning environments/applications; Tools for interactive learning and teaching; Platforms and authoring tools; Adaptive learning environments; Applications if the semantic Web; Methods of content adoption; Standards and styleguides; Knowledge management and learning; Collaborative learning; Remote and virtual laboratories; Multimedia applications and virtual reality; Pedagogical and psychological issues. For more information: http://www.icl-conference.org/	**Villach, Austria**

When	What	Where
October 25 – 28, 2005	**4th World Conference on mLearning** mLearn 2005, the 4th World conference on mLearning, will fulfil the need for stimulating critical debate on and research into theories, approaches, principles and applications of mLearning (mobile learning). It will provide an opportunity for professionals from industry, as well as researchers, educators, technologists and practitioners, to share their knowledge, experience and research in the various areas where mLearning is applied. The conference will also serve as an incubator to promote mLearning in Africa. Two mobile learning projects, both supported by the European Commission, have collaborated to organise a series of international conferences on Mobile and Ambient Learning. Both projects brought an international perspective to the conferences - MOBIlearn has partners in Australia, Finland, Germany, Greece, Israel, Italy, Spain, Switzerland, the UK and USA, and m-learning has partners in Italy, Sweden and the UK. The objectives for the conference have been defined as follows: to promote the development of mLearning, globally, but especially in developing countries; to stimulate critical debate on and research into theories, approaches, principles and applications of mLearning (mobile learning); to share local and international developments, experiences and lessons learned; to promote networking and business opportunity development; to encourage the study and implementation of mobile applications in teaching and learning; to stimulate and assist personal professional development and the development of new skills for educators; to provide a forum for education and knowledge transfer; to facilitate dialogue, sharing and networking between diverse cultures with regard to the optimum use of emerging technologies. For more information: http://www.mlearn.org.za/	**Cape Town, South Africa**
November, 1, 2005	**The Second International Workshop on Grid Computing and its Application to Data Analysis (GADA'05)** The great challenge of grid computing is the complete integration of heterogeneous computing systems and data resources with the aim of providing a global computing space. The achievement of this goal will involve revolutionary changes in the field of computation, because it will enable resource-sharing across networks, being data one of the most important ones. This workshop is intended for researchers in grid computing, who want to extend their background on this area and more specifically to those that use grid environments for managing and analysing data. Topics of interest include, but are not limited to: Computational grids; Data integration on grids; Grid-based data mining; Grid solutions for data-intensive applications; Grid infrastructures for data analysis; High-performance computing for data-intensive applications; Grid computing infrastructures, middleware and tools; Grid computing services; Grid and cluster computing; Collaboration technologies; Data analysis and management; Databases and the grid; Extracting knowledge from data grids; Agent-based management of data in distributed systems; Agent architectures for grid environments; Semantic Grid; Data grids for bioinformatics; Security in data grids For more information: http://www.cs.rmit.edu.au/fedconf/gada2005cfp.html	**Agia Napa, Cyprus**

When	What	Where
November 28 - 29, 2005	**1st International Conference on Semantics, Knowledge and Grid** The Internet and World Wide Web are milestones of information sharing. IT professionals are in the critical historical stage of creating the new brilliance --- a new interconnection environment. Semantics and knowledge have become the kernel issues in developing the new environment. The 1st International Conference on Semantics, Knowledge and Grid (SKG 2005) is to bring together researchers and practitioners in areas of knowledge and intelligence, semantics, and grid computing to share their visions, research achievements and solutions to real problems, to attack the challenge issues, and to establish worldwide cooperative research and development. For more information: http://kg.ict.ac.cn/SKG2005/	**Beijing, China**
November 30, December 2, 2005	**11th International Conference on Technology Supported Learning and training, ONLINE EDUCA BERLIN 2005** Meeting the networking needs of the international e-learning and distance education industry, the annual Online Educa Berlin conference is the **key networking venue for strategists and practitioners from all over the world**. The **Kaleidoscope Network of Excellence** in technology-enhanced learning and **eLIG** (European eLearning Industry Group) will bring together industry and academia to discuss the creation of a good practice model for linking scientific research and innovation. Also put under the microscope will be industrial exploitation in technology-enhanced learning for shared understanding and consensus on the priorities of basic research in the field. For more information: http://www.online-educa.com/en/	**Berlin, Germnay**
December, 5 – 8, 2005	**e-Science 2005 – International Conference on e-Science and Grid technologies** The next generation of scientific research and experiments will be carried out by communities of researchers from organizations that span national boundaries. These activities will involve geographically distributed and heterogeneous resources such as computational systems, scientific instruments, databases, sensors, software components, networks, and people. Such large-scale and enhanced scientific endeavors, popularly termed as e-Science, are carried out via collaborations on a global scale. Grid computing has emerged as one of the key computing paradigms that enable the creation and management of Internet-based utility computing infrastructure, called Cyberinfrastructure, for realization of e-Science and e-Business at the global level. Several national and international projects around the world have been initiated to carry out research and innovation activities that transform the vision of e-Science and Grid computing into reality. The e-Science 2005 conference, sponsored by the IEEE Computer Society Technical Committee for Scalable Computing (TCSC) and Society for Industrial and Applied Mathematics, is designed to bring together leading international and interdisciplinary research communities, developers, and users of e-Science applications and enabling IT technologies. The conference serves as a forum to present the results of the latest research and product/tool developments, and highlight related activities from around the world. For more information: http://www.gridbus.org/escience/	**Melbourne , Australia**

When	What	Where
January, 18 - 19, 2006	**Thirteenth Annual Multimedia Computing and Networking (MMCN'06)** The objective of this conference is to bring together researchers and practitioners contributing to all facets of multimedia computing and networking. We especially encourage full and original papers on emerging technologies such as residential broadband networks and digital appliances, multimedia and QoS support for 3G and ad hoc networks, multimedia in P2P environments, sensor networks and grids, power-aware computing and communications, mobile and fixed wireless multimedia networks and content distribution networks. We will specially feature industrial design experiences and showcase tools for next-generation multimedia systems and applications. Presenters are encouraged to make multimedia presentations and demonstrate their solutions in person. For more information: http://www.ifi.uio.no/mmcn2006/	**San Jose, California**