Learning Grid

A newsletter from the Kaleidoscope Learning Grid SIG **Chief Editor: Nicola Capuano**

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In this Issue:

Editorial

The main purpose of this newsletter is to resume some of the results of the Learning Grid Special Interest Group about the adaptation of educational modelling languages and service composition languages to be exploited in Learning Grid environments.

The two articles here presented will analyse existing languages and frameworks for the dynamic composition of distributed resources and services with particular emphasis on those that may be exploited in a Learning Grid. These languages are of a paramount importance in such environment where heterogeneous learning services are distributed and have to be dynamically composed according to learners needs and preferences and teacher defined learning methods.

The first article will analyse education modelling languages i.e. languages specifically created to manage workflows of learning activities (so learning oriented but not specifically service-oriented); the second will deepen services composition languages i.e. languages specifically created for static and/or dynamic composition of Web services of any nature (so service-oriented but not specifically learning-oriented).

Among available education modelling languages we will deepen IMS Learning Design and UNED Palo. A brief description of EML, TML, CDF, LMML and Targeteam will be also provided mainly for historical reasons. Among service composition languages we will focus on the most diffused BPEL4WS, WS-CDL and OWL-S while briefly describing also BPML, XPDL, WSCI and CCML.

In both cases, after a description of available languages, frameworks and related tools, specific paragraphs are dedicated to language comparison and to the definition of eventual extensions needed in order to be fully exploitable in a Learning Grid environment.

Moreover, let me exploit this space to give also some “internal” news related to our Special Interest Group. Our last review from EC was held in Granada, Spain, from 12 to 14 March 2007. The review was successful for the Kaleidoscope project in general and for our SIG in particular: all SIG deliverables were accepted and EC reviewers stated on their report that “the SIG has performed better than in previous years”.

Other news are related to the new SIG workshop “Ontologies and Semantic Web Services for Intelligent Distributed Educational Systems” that will be held in Marina Del Rey, California, USA, in the context of the 13th International Conference on Artificial Intelligence in Education (AIED 2007) from 8 to 13 July 2007.

Another workshop in 2007 will be co-organized by our SIG: the “International Workshop on Collaborative System Design and Applications” that will be held in Rio de Janeiro, Brazil, in conjunction with the 7th International Conference on Intelligent Systems Design and Applications (ISDA 2007) from 22 to 24 October 2007.

Call for papers for both workshops are included in this issue of the newsletter.

Nicola Capuano

CRMPA - Centro di Ricerca in Matematica Pura ed Applicata

Fifth International Workshop on

Ontologies and Semantic Web Services for Intelligent Distributed Educational Systems (SWEL'07)

July 9-13, 2007, Marina Del Rey, California, USA

Workshop Organizers: Nicola Capuano, Darina Dicheva, Andreas Harrer, Riichiro Mizoguchi

Special Session on

Ontologies and Semantic Web Standards for e-Learning

Session co-chairs
Darina Dicheva, Winston-Salem State University, USA
Riichiro Mizoguchi, University of Osaka, Japan

Special Session on

Semantic Grid Architectures and e-Learning Services

Session co-chairs
Nicola Capuano, University of Salerno, Italy
Andreas Harrer, University of Duisburg-Essen, Germany

This workshop, organised inside **AIED 2007**, will focus on Semantic Web based knowledge representation, Grid technologies, engineering approaches and methods for the design, development and experimentation of intelligent distributed educational systems. It will discuss issues related to the use of ontologies, Semantic Web standards, distributed processes and systems enabled by Grid technologies for learning content delivery, services and knowledge components specification, effective intelligent courseware construction, and learner modelling.

SWEL'07 is the fifth in the series. This edition has a special focus on service oriented Semantic Grid Architectures for e-Learning and is organized together with two Special Interest Groups of the European Network of Excellence Kaleidoscope: Artificial Intelligence and Education, and Learning Grid.

The workshop goals are:

– To discuss the current state-of-the-art in using ontologies and Semantic Web and Grid methodologies, technologies and standards in intelligent and distributed educational systems.
– To attract the interest of the related research communities to the problems in adaptive educational hypermedia and serve as an international platform for knowledge exchange and cooperation between researchers.

Topics of Interest

High quality research papers are encouraged, including position papers and work in progress, in order to present the current state of the art on various perspectives of intelligent and distributed educational systems within the context of educational Semantic Web and Grid. They will serve as an input for a scientific discussion to identify main problems and to set the basis for novel solutions. Participation of young researchers is encouraged.

Workshop topics of interest include, but are not restricted, to:

- **Session on Ontologies and Semantic Web Standards for e-Learning**
  – Building ontologies for e-learning: ontology development; theoretical issues in ontology engineering.
  – Using ontologies and Semantic Web standards for structuring, representing, indexing, and retrieving shareable and interoperable learning resources (including individual and community-based annotation).
  – Using ontologies and Semantic Web standards for supporting authoring of intelligent educational systems.
  – Using Semantic Web-based contexts for adaptation and personalization of e-learning applications.
  – Towards Semantic Web-based Educational standards: new ideas, extending/mapping of existing ones, etc.
  – Real-world systems, case studies and empirical research for Semantic Web-based educational systems.
  – Session on Semantic Grid Architectures and e-Learning Services
- **Semantic Grid architectures and systems for distributed intelligent e-learning.**
  – Models and tools for the semantic annotation of e-learning services.
  – Methods and systems for the automatic composition of semantically described services and processes.

- Pedagogical approaches and learning models for exploiting the potential of distributed and Grid technologies for learning.
- Application scenarios for dynamic composition of distributed learning services using AIED and GRID technologies and techniques.

The accepted workshop papers will be printed in the **AIED 2007** workshop proceedings. After the workshop, they will be also made available online at the workshop website. Possibilities will be investigated to publish the best workshop papers in a special issue of a refereed journal.

Format

The AIED'07 session of SWEL is planned as a full day workshop consisting of the following:

- Keynote talk - 1 hour:
  Riichiro Mizoguchi "Inside theory-aware and standards-compliant authoring system"
- Paper presentation sessions - 20 minutes per paper including 5 minutes for discussion
  - Session on Ontologies and Semantic Web Standards for e-Learning
    Session Chairs: Darina Dicheva and Riichiro Mizoguchi
  - Session on Semantic Grid Architectures and e-Learning Services
    Session Chairs: Nicola Capuano and Andreas Harrer
- Poster and Software demonstration session – 2 hours
- Discussion Panel (panellists will be invited to present key questions for discussion and their positions) – 1 hour

Important Dates

Paper submission: **1 May 2007** (extended)

Notification: **20 May 2007**

Camera-ready submission: **15 June 2007**

Workshop day: **9 July 2007**

Web Site: http://compsci.wssu.edu/iis/swel/

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Education Modelling Languages and Learning Grid

The purpose of this article is to analyse existing education modelling languages and frameworks and their application in a Learning Grid environment for the dynamic composition of distributed e-learning resources and services.

1. Introduction

An EML is a semantic notation for units of learning to be used in e-learning to support the reuse of pedagogical entities like learning designs, learning objectives, learning activities, etc. EMLs constitute an evolution of the content-centered specifications of learning material, involving the description of learning processes and methods from a pedagogical and instructional perspective. In other words, an Educational Modelling Language (EML) is a modus operandi that describes "units of learning" in a pedagogical way.

EMLs and learning objects actually represent opposite approaches to the interoperability question. As far as the learning objects approach is concerned, interoperability for content is hampered by the contextual "baggage" of the object; an object can only truly be reusable by stripping the content of all its external referents such as teaching methods, student roles, and activities. EMLs take an opposite approach: they conclude that components are truly shareable and reusable if all units include complete lessons, hands on work, or entire courses and all contextual information. Moreover EMLs incorporate the definition of pedagogical aspects and learning processes that make interoperable courses or units of study, so they provide appropriate instructional elements at its adequate abstraction level.

Several educational modelling languages have been defined till now. The next two paragraphs of this will deal with the description of the two most diffused EMLs: IMS Learning Design and UNED Palo. A subsequent paragraph will deal with less diffused languages like EML, TML, CDF, LMML and Targeteam.

A further paragraph will provide a comparison of all studied languages taking in mind the Learning Grid as their application environment and will suggest extension needed to such kind of languages to be exploited in a Learning Grid environment mainly related, we will see, to semantic description and late binding of learning resources and services.

2. IMS Learning Design

Learning Design (LD) [1] is a specification describing a semantic notation for education, developed by the IMS Working Group on Learning Design. Through Learning Design it is possible to describe a wide variety of pedagogical models, or approaches to learning, including group work and collaborative learning. It does not define individual pedagogical models but provides an high level language that can describe many different models. The language describes how people perform activities using resources, and how these things are coordinated into a learning flow.

The core concept of the LD specification is that a person gets a role in the learning process, typically a learner or a staff role. The environment consists of the appropriate LOs and services to be used during the performance of the activities. Which role gets which activities at what moment in the process, is determined by the method or by a notification.

IMS LD provides a level of abstraction in the learning process, offering generic constructs capable of building different pedagogical approaches. The IMS LD specification is sometimes discussed in terms of pedagogical neutrality, since no single pedagogy is inherent in, or implied by, the specification. However, it is important to emphasise that pedagogy is fundamental to the use of IMS LD. Using the specification requires a designer to think which objectives a learning process is designed to achieve and which pre-requisites are involved, to identify the activities learners and staff should undertake and which tools should be used in the process.

IMS Learning Design describes how a learning design scenario unfolds through the analogy of a theatrical play. Just as a play can be staged with different actors, in a different theatre with alternative props, so learning design scenarios can be executed again with different learners and tutors, on different systems, with alternative learning resources or tools.

To facilitate both the production of the specification and its subsequent implementation, Learning Design has been divided into three parts, known as Level A, Level B, and Level C. Separate XML schemas are provided for each level, each integrating with and extending the previous Level.

The **level A** contains the core of IMS LD: people, activities and resources, and their coordination through the method, play, act and role-parts elements. This simply allows a series of time ordered learning activities to be performed by learners and teachers, using LOs and services. The main added value to e-learning of Level A is that it defines Activities and Roles as reusable components that can be designed into a work-flow using the Method element. It also allows Services such as email and conferencing to be specified at design time as placeholders within the design that will be instantiated by the run-time system.

The **level B** allows the inclusion of properties and conditions. Two types of property have been proposed: Internal and External. They are used to store information about a person, such as test results or learner preferences; a role, such as whether the role is for a full-time or part-time learner; or a learning design itself. Internal properties persist only during a single run of a learning design, while external properties retain their values beyond the end of a run, and can be accessed from different runs and different learning designs. Currently the reuse of external properties is confined to the learning design author or to agreed usage within a community or institution. However, it is intended that external properties will include the use of those that are defined externally and widely agreed upon, such as the accessibility fields defined in the IMS Learner Information Package (IMS LIP) specification. Conditions allow the learning flow to be constrained according to specific circumstances, preferences or learner characteristics. For instance, a particular learner may be presented with resources in random order, if their learning style or preference requires this.

The **Level C** provides a notification capability that allows messaging between system components and means the flow of events could be adapted at run-time based on event triggers such as completion of earlier tasks. This paves the way for adaptive sequencing capabilities as well as role-play and event-driven simulations.

IMS LD orchestrates e-learning scenarios by describing and implementing learning activities based on different pedagogies (including group work and collaborative learning); by coordinating multiple learners and multiple roles within a multi-learner model or, alternatively, by supporting single learner activities; by coordinating the use of learning contents with collaborative services and by supporting multiple delivery models (including mixed-mode learning).

3. UNED PALO

PALO is a proposal of Education Modelling Language developed by the Universidad Nacional de Educación a Distancia (UNED) of Madrid [2]. Since 1988 to describe and design learning content and learning environments at an high abstraction level.

The PALO Language allows the definitions of courses or units of study structured in modules. Each module includes a declaration of the structure, activities to be undertaken by students and tutors and the schedule of activities and content. The sequencing of modules is scheduled through deadlines and dependence between modules, based on different types of prerequisites.

In accordance with recent trends for reusability and interoperability in Learning Technologies, the PALO Language, provides a layer of abstraction for the description of learning material, including the description of learning activities, structure and scheduling. In particular the language provides mechanism to express the following aspects:

– contents and references to the domain model;
– structure and navigational model including style and presentation;
– degree of interactivity for a remote o local usage;
– user access and tracing.

The description language is composed by a group of structure dependant tags and a group of domain model related tags. Tag attributes also play an important role on defining some other aspects of the final environment. The system includes also an editor to create a document from a template and a PALO compiler able to process an instantiated template and build a Web environment with the structure.

In PALO, activity scheduling is done using language attributes. These attributes define deadlines and dependencies between activities (or modules) based on different prerequisite types. PALO defines learning strategies with instructional templates which are some scenario models with particular pedagogical properties (for example a constructive approach or a behavioural one). Thus PALO can be extended each time there is a need for a certain pedagogical functionality.

PALO defines learning scenarios by mean of instructional templates. An instructional template defines a type of learning scenario with certain pedagogical properties. Pedagogical domain is defined by mean of elements of the language that provides different functionality. Instructional templates, however, do not define different “languages” by themselves, but a subset of the element of the language that provides a certain type of pedagogical functionality. A group of consistent elements of PALO that provide an instructional or pedagogical purpose constitute a template.

Particularly the Palo Language consists of five layers:

– Layer 1: Educational or Content layer;

– Layer 2: Activity and cooperative model;

– Layer 3: Structure;

– Layer 4: Sequencing and Scheduling;

– Layer 5: Management.

Each layer, for a given template will contain a selection of elements from the information model. Whether to create elements of the information model for all these categories or not, depends on the template. At the same time, the utility of this classification is also to provide a framework to compare different EML proposals.

Differently from IMS LD, PALO tools are very few and only available as academic prototypes. The only tool available online is a PALO compiler (*paloc*) able to process an instantiated template and build a Web environment with the structure, content and features described in the document. No authoring tools have been developed till now and documents are written using SGML and XML editors.

4. Other Languages

Apart the most diffused IMS Learning Design and UNED PALO, several other Educational Modelling Languages have been proposed in literature. Some of these languages have had a very limited diffusion, some others have stopped their evolution given the wide diffusion of IMS Learning Design.

EML (Education Modelling Language) [3] was developed by the Open University of the Netherlands (OUNL) analysing a wide range of pedagogical approaches. EML has been selected as the base for the IMS Learning Design specification, where it is integrated with IMS Content Packaging and IMS Simple Sequencing.

This specification tries to capture the pedagogical diversity so designs might involve a single user or multiple users. The rationale of this specification is that regardless of the pedagogy involved, in practice a learning design specification comes down to a Method prescribing various activities for learner and staff roles in a certain order. Each activity refers to a collection of specific objects and services (called the environment) needed to perform the activity.

Previous learning technology specifications allowed only for some simple ordering and sequencing of resources used in e-learning (e.g. SCORM, IMS Content Packaging, IMS Simple Sequencing). EML added to this the ability to integrate learning designs (instructional designs) to enable more advanced e-learning applications, e.g. to model competency based education, portfolio's, collaborative learning. EML provides a semantic information model and several bindings (in SGML and XML).

TML (Tutorial Markup Language) [4] is an interchange framework designed to separate the semantic content of a question from its screen layout or formatting developed in the context of NetQuest, a project of the ILRT, University of Bristol (UK). The language is designed to support several different types of question within the same content model.

TML is essentially a super-set of HTML, with new elements added to describe question information. TML version 4.0 has been specified using SGML, an ISO standard language for formally describing document types. Work on TML 5.0 is supported in part by the JISC JTAP programme.

The TML software distribution is freely available as an example implementation of the language specification. Its main features include: standards-based content interchange formats; integration with digital library resource banks; open source software for Unix and Windows available.

CDF [5] (Curriculum Description Format) is implemented as an editor tool and provides a powerful design framework for pedagogical engineers and ODL trainers, for many kind of technology-supported learning processes.

CDF comprises seven categories of elements that enable the description of general characteristics of the curriculum at design and ordering time; information on the target learner population; list of session types defined for and used in this course; list of actual sessions defined for this course; list of communication resources needed for this course; list of teaching staff members involved in this course; list of generic or actual physical locations needed for all kinds of learning activities included in this course.

LMML (Learning Material Markup Language) [6] is developed at the University of Passau, Germany as an adaptable and extensible family of XML markup languages for learning and teaching material. It provides sub-languages for several educational fields and is currently used in university education, further education as well as company training.

LMML consists of several modules which in turn may contain further modules. The structure of LMML-documents, and therefore the form of the resulting learning material, is defined by DTD modules. The basic units of information in this module-hierarchy considered relevant by the provider of educational content are called ContentModules, e.g. definition or motivation.

They contain Media Objects, for instance pictures, animations or text that can be structured as lists or tables. Because of this, learning material reveals a hierarchical structure.

Targeteam [7] is developed by the Universitet der Bundeswehr, Munchen. It is a system for supporting the preparation, use, and reuse of teaching materials centred around the XML based language TeachML. It supports representing, structuring, and managing content used in all kinds of learning situations as well as the production of these materials, their flexible reuse, and the generation of different delivery formats which are used in the learning process.

Targeteam does not actively support the learning process itself. The information model consists of a homogeneous hierarchy of neutral paragraph-sized issues containing text or media objects such as images, animations or applets. Additional metadata can be attached on all levels to identify the educational purpose of the issue, such as illustration, exercise, explanation, motivation etc.

Targeteam is based on the assumption that this structure is crucial for providing an understanding for the learners. A simple linear sequence of standalone “learning modules” is not sufficient. However, Targeteam has been designed to cover the full spectrum of learning materials, from unstructured fragments up to highly structured content collections.

5. Language Comparison

To give an overview and to facilitate a comparison of all studied languages, this paragraph puts together in a single table their main features.

The outcome of this comparison makes clear that the scope of the presented languages differs very much. There appear to be two groups: the first group, consisting of CDF, LMML, TML and Targeteam, seems to be “ignorant” in expressing pedagogical models. The second group consisting of IMS-LD/EML and PALO are semantic rich information models able to describe the content and process within ‘units of learning’ from a pedagogical perspective.

From the two, moreover, while IMS-LS fully lives up to this definition, PALO is limited to the definition of individual tasks. Nevertheless at this stage it is already clear that the expressive power of the current version of IMS-LD, by simply studying and looking at the number of defined elements and attributes, exceeds the expressive power of PALO.

It is important to note, moreover, that currently IMS-LD is the only language which both is compatible with various international standards and follows the process and procedures to be accepted as a standard. Moreover a lot of high-level user-friendly editing and executing tools are already available for IMS-LD. For this reason IMS-LD is currently the widest diffused education modelling language and the one more feasible to be used as the basis in a Learning Grid environment.

Nevertheless IMS Learning Design is currently hardly exploitable in distributed e-learning environments due to several limitations coming from design-time resource binding. Design-time resources binding in fact is affected by the following problems:

– *Learning design scenarios implement domain-dependent pedagogies*: the instructional designer is forced to establish “a priori” the didactic domain, building the environments tied to the scenario’s activities.

– *Learning processes cannot be really adaptive (based on learner profiles)*: systems for learning material delivery cannot take into account learner preferences and cannot select, at run-time, learning objects that best fit learners characteristics.

– *E-learning scenarios don’t exploit some advantages of distributed infrastructures*: the early binding of resources at design-time thwarts the opportunity for dynamic selection of learning objects and services that best fits learning process needs. Of course, these needs can be better supplied if the source of resources is a whole virtual organization (on a networked infrastructure) than the environments linked to the learning design scenario.

In [8] a solution is proposed to overcome these issues. It consists in modifying the learning design scenario authoring process specified by IMS-LD in order to provide only requirements for a desired LO rather than a reference to a real LO. Requirements can be expressed using a subset of IMS Learning Resource Metadata (IMS-MD) specification.

These requirements will be transformed in references to real LOs at learning design scenario execution-time. A learning design scenario with pending references to LOs can be then considered a template learning design scenario [9].

References

[1] IMS Learning Design Consortium http://www.imsglobal.org/learningdesign

[2] Universidad Nacional de Educación a Distencia de Madrid http://portal.uned.es

[3] Website on Educational Modelling Language (EML) http://www.learningnetworks.org

[4] NETQUEST Projec http://www.cti.ac.at/netquest

[5] ARIADNE Foundation for the European Knowledge Pool http://www.ariadne-eu.org

[6] University of Passau http://www.lmml.de/

[7] Universit"t der Bundeswehr, Mnchen http://www.unibw.de/startseite

[8] N. Capuano, M. Gaeta, R. Iannone, F. Orciuoli. Learning Design and run-time resource binding in a distributed e-learning environment. Proceedings of the 1st International Kaleidoscope Learning GRID SIG Workshop on Distributed e-Learning Environments, March 14 2005, Vico Equense (NA), Italy.

[9] Pythagoras Karampiperis and Demetrios Sampson - Designing Learning Services for Open Learning Systems Utilizing IMS Learning Design.

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	IMS-LD / EML	PALO	TML	CDF	LMML	TARGETEAM
Semantic information model available	Y	Y	Y	Y	Y	N
Models a 'unit of learning'	Y	Y	N/A	Y	Y	Y
Language(s) of binding	XML, SGML	XML, SGML	XML, SGML	XML	XML	XML
One generic model and binding?	Y	N	Y	Y	Y	Y
Includes complete process description	Y	Y	N	Y	Y	Y
Pedagogical perspective	Pedagogical meta-language to express all types of pedagogical models	It can be extended to support new pedagogical functionalities	Restricted to tutorial models and assessment	It is not possible to actually express a pedagogical mode	It is possible to express pedagogical models using sub-typing	It is not possible to actually express a pedagogical model
Re-usability	Y	Y	Y	Y	Y	Y
Integration of other Standards	LOM, IMS CP, IMS SS, WfMC, XHTML	Dublin Core, HTML, LaTeX	HTML	LOM	Extension mechanism for standard supp.	
Main scope of the entities in the information model.	Content and process	Content and process	Limited to questions	Limited to content and resources	Limited to content and domain specific.	Limited to content.
Main semantic entities in the information model.	objective; prerequisite; role; activity; environment; object; method	course; module; activity; LO; learning content	question type; choice; hint; response; score	general; target learner; sessions type; sessions; teachers; locations	module; structure model; content module; structure object	hierarchy of paragraph sized issues
Do academics use the system operationally	Y	Y	N	Y	Y	Y
Was the language developed within a partnership?	Companies, institutes and standard bodies	In-house	Open source	Academic and no-profit associations	Academic	Academic
What are the authoring tools like? Are they user friendly or low-level	About 20 tools currently available. Several are user-friendly.	Standard SGML and XML editors; XEmacs.	Text-based mark up.	Any authoring tool can be used.	Standard XML tools and some specialized tools.	Standard XML editors and some system specific tools.

Service Composition Languages and Learning Grid

The purpose of this article is to analyse existing service composition languages and frameworks and their application in a Learning Grid environment for the dynamic composition of distributed e-learning resources and services.

1. Introduction

Web services (SWSs) are defined as self-contained, modular units of application logic which provide business functionality to other applications via an Internet connection. Web Services support the interaction of business partners and their processes by providing a stateless model of "atomic" synchronous or asynchronous message exchanges.

A relevant feature for Web services is the mechanism for their reuse when complex tasks are carried out. It is often the case, to define new processes out of finer-grained subtasks that are likely available as Web services. To this aim, extensions of the Web service technology are considered which support the definition of complex services out of simpler ones.

Composition rules deal with how different services are composed into a coherent global service. In particular, they specify the order in which services are invoked, and the conditions under which a certain service may or may not be invoked. Two possible approaches are currently investigated for the static service composition.

– The first approach, referred to as *Web services orchestration*, combines available services adding a central coordinator (the "orchestrator") which is responsible for invoking and combining the single sub-activities.

– The second approach, referred to as *Web services choreography*, does not assume the exploitation of a central coordinator but it defines complex tasks via the definition of the conversation that should be undertaken by each participant. Following this approach, the overall activity is achieved as the composition of peer-to-peer interactions among the collaborating services.

Several proposal already exist for orchestration languages, among the others paragraph 2 will describe BPEL4WS. On the contrary, choreography languages are still at a preliminary stage of definition. A proposal, named WS-CDL (described in paragraph 3) has been issued from W3C in December 2004.

Unfortunately, neither current orchestration and choreography languages nor Web service description standards (like WSDL) deal with the dynamic composition of services. They in fact conversely focus on representing composition where the information flow and the binding between services are known a priori. A more challenging problem is to compose services dynamically (e.g. when a functionality that cannot be provided by the existing services is required, the existing services can combined together to fulfil the request).

The dynamic composition of services requires the location of services based on their capabilities and the recognition of those services that can be matched together to create a composition. The full automation of this process is still the object of ongoing research activity, but the right path seems that given by Semantic Web languages like OWL-S (see paragraph 4).

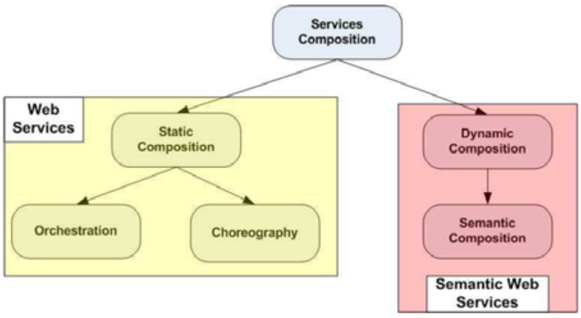
While WSDL provides a function-centric description of Web services covering inputs, outputs and exception handling, on the other side, OWL-S provides a process level description of the service which, in addition to functional information, models the preconditions and postconditions of the process so that the evolution of the domain can be logically inferred. It relies on ontologies to formalize domain concepts which are shared among services.

OWL-S efforts aim at fully automating all the stages of the Web services lifecycle. With the Semantic Web infrastructure in place, practical and powerful applications can be written that use annotations and suitable inference engines to automatically discover, execute, compose, and interoperate Web services.

The following picture summarises the different approaches available for service composition.

The next three paragraphs will deal with the description of the three most diffused service composition languages from three different groups: BPEL4WS for the orchestration model, WS-CDL for the choreography model and OWL-S for the semantic composition model. A further paragraph will briefly describe more, less used, languages for services composition.

A further paragraph will provide a comparison of studied languages taking in mind the Learning Grid as their application environment while a last paragraph (for this section) is about extension needed to such kind of languages to be exploited in a Learning Grid environment.



Different approaches available for service composition

2. BPEL4WS

The Business Process Execution Language for Web Services (BPEL4WS) [1] is an initiative of the industry leaders BEA, IBM, Microsoft, SAP, Siebel to drive and ensure interoperability for the description and communication of business processes based on Web Services. Particularly BPEL4WS builds on IBM's WSFL and Microsoft's XLANG. Accordingly, it combines the features of a block structured process language like XLANG with those of a graph-based process language like WSFL.

Processes in BPEL4WS export and import functionality by using Web Service interfaces exclusively. It provides a language for the formal specification of business processes and business interaction protocols. By doing so, it extends the Web Services interaction model and enables it to support business transactions. BPEL4WS defines an interoperable integration model that should facilitate the expansion of automated process integration in both the intra-corporate and the business-to-business spaces. BPEL4WS represents a convergence of the ideas in the XLANG and WSFL specifications. Both XLANG and WSFL are superseded by the BPEL4WS specification.

In BPEL4WS, processes can be described in two ways. Executable business processes model actual behaviour of a participant in a business interaction. Business protocols, in contrast, use process descriptions that specify the mutually visible message exchange behaviour of each of the parties involved in the protocol, without revealing their internal behaviour. The process descriptions for business protocols are called abstract processes. Essentially, executable processes provide the orchestration support described earlier while the business protocols focus more on the choreography of the services.

At the core of the BPEL4WS process model is the notion of peer-to-peer interaction between services described in WSDL; both the process and its partners are modelled as WSDL services. A business process defines how to coordinate the interactions between a process instance and its partners. In this sense, a BPEL4WS process definition provides and/or uses one or more WSDL services, and provides the description of the behaviour and interactions of a process instance relative to its partners and resources through Web Service interfaces.

BPEL4WS defines the message exchange protocols followed by the business process of a specific role in the interaction. The definition of a BPEL4WS business process also follows the WSDL model of separation between the abstract message contents used by the business process and deployment information.

Probably because of the youth of BPEL4WS technology and the complexity of these systems, the number of running open source implementations of the BPEL specification is currently low. Among BPELWS implementations currently exist there are: Microsoft BizTalk, IBM BPWS4J, Active BPEL, Oracle BPEL Process Manager, Agila BPEL, Digité Process Composer, WebSphere Process Server, OpenLink Virtuoso Universal Server, Parasoft BPEL Maestro, SAP NetWeaver Exchange Infrastructure, Sun Microsystems eInsight BPM, Bexee, BPEL Process eXecution Engine.

3. WS-CDL

WS-CDL [2] is a choreography model that describes a collaboration between a collection of services in order to achieve a common goal. It captures the interactions in which the participating services engage to achieve this goal and the dependencies between these interactions, including control-flow dependencies, data-flow dependencies, message correlations, time constraints, transactional dependencies, etc.

A choreography does not describe any internal action that occurs within a participating service that does not directly result in an externally visible effect, such as an internal computation or data transformation. A choreography captures interactions from a global perspective, meaning that all participating services are treated equally. In other words, a choreography encompasses all the interactions between the participating services that are relevant with respect to the choreography's goal.

The Web Services Choreography Description Language is an XML-based language that describes peer-to-peer collaborations of participants by defining, from a global viewpoint, their common and complementary observable behaviour; where ordered message exchanges result in accomplishing a common business goal.

WS-CDL is a layered language. It provides different levels of express ability to describe a choreography.

The substrate of the choreography are abstract request/response operations that are referenced by *interactions*. An interaction is the realization of a collaboration between roles. Roles are grouped into participants. Roles are analogous to the entities at the top of our UML sequence diagrams and participants group these roles into domains of control which can be said to be the location the behaviours defined by the roles. An interaction must specify what relationship it is bound too.

In WS-CDL each role defined has a behaviour. A behaviour in this sense is the binding point for a WSDL description. The binding point is the interface which normally references a WSDL description but this is optional in WS-CDL. Because it is optional we can use this as a binding point to different service descriptions. The WS-CDL choreography definition is relatively classic: it has the good old sequence / parallel / choice construct, along with assign. Recursive composition is achieved with the perform element.

In terms of messaging quality of service, WS-CDL relies on WS-Reliable-Messaging principally. The extent of quality of service messaging on which WS-CDL depends is not fully established, and the mapping for reliable messaging at the very least remains open. In general, no a priori configurability of WS-CDL specifications for different quality of messaging service is in place. This limits the layering and exploitation of choreography for lower level services from current and oncoming messaging standards.

Among the more main tools, systems and frameworks needed to support WS-CDL specifications at different levels there are: Pi4SOA CDL Editor and WS-CDL Eclipse.

4. OWL-S

Web Services (WS) promise to provide solutions to the challenges associated with automated discovery, dynamic composition, enactment, and other tasks associated with managing and using service-based systems.

One of the barriers to a wider adoption of WS technology is the lack of tools for creating WS specifications. OWL-S [3] tries to overcome this barrier by supplying a Web service designer with a core set of markup language constructs for describing the properties and capabilities of a Web service in unambiguous, computer-interpretable form. OWL-S markup of Web services facilitates the automation of Web service tasks including automated discovery, execution, interoperation, composition and execution monitoring.

Following the layered approach to markup language development, the current version of OWL-S builds on top of Ontology Web Language (OWL). OWL-S introduces ontologies to describe, on the one hand, the concepts in the services' domain and, on the other hand, generic concepts to describe the services themselves and how they relate to the domain ontologies. These semantically rich descriptions enable automated machine reasoning over service and domain descriptions supporting automation of service discovery, composition and execution reducing manual configuration and programming efforts.

The following three task types will give an idea of the kinds of tasks that OWL-S enables.

– **Automatic Web service discovery**. It is an automated process for location of Web services that can provide a particular class of service capabilities, while adhering to some client-specified constraints.

– **Automatic Web service invocation**. It is the automatic invocation of a Web service by a computer program or agent, given only a declarative description of that service, as opposed to when the agent has been pre-programmed to be able to call that particular service.

– **Automatic Web service composition and interoperation**. It involves the automatic selection, composition and interoperation of

Web services to perform some complex task, given a high-level description of an objective.

With OWL-S markup of Web services, the information necessary to select and compose services will be encoded at the service Web sites. Software can be written to manipulate these representations, together with a specification of the objectives of the task, to achieve the task automatically. To support this, OWL-S provides declarative specifications of the prerequisites and consequences of application of individual services, and a language for describing service compositions and data flow interactions.

The overall structure of the ontology and its three main parts: the service profile for advertising and discovering services; the process model that describes how a service performs its tasks; and the grounding, which provides details on how to interoperate with a service, via messages.

A set of OWL-S tools exists but a complete execution environment based on OWL-S concepts is still lacking. For example, OWL-S Editors allow the maintaining of OWL-S service descriptions, OWL-S Composer provides an algorithm for different degrees of matching for individual elements of OWL-S, OWL-S Axis plug-in advices service providers on how to provide service description using OWL Services, etc.

5. Other Languages

An overview of further Services composition languages and frameworks, namely BPML, XPDL, WSCI and CCML, is presented below.

BPML [4] is a standard proposed by Business Process Management Initiative and was originally developed to enable the standard-based management of e-business processes used with Business Process Management System (BPMS) technology. The Business Process Modelling Language is a process definition language intended for expressing abstract and executable processes that address enterprise business processes, including in particular those areas important for Web based services.

BPML is a specification language designed for executable business processes. It can be applied to enterprise application integration and Web services composition. BPML includes support on control flow, data flow and event flow with structures of sending, receiving and invoking services, and control structures of conditional choice, sequential, iteration and parallel execution with synchronization.

BPML provides an abstract model and XML syntax for describing executable business processes and supporting entities and is dependent on XML 1.0, XML Schema 1.0, XML Namespaces and XPath 1.0.

XPDL (XML Process Definition Language) [5] is conceived of as a graph-structured language with additional concepts to handle blocks. Scoping issues are relevant at the package and process levels. Process definitions cannot be nested. Routing is handled by specification of transitions between activities. The activities in a process can be thought of as the nodes of a directed graph, with the transitions being the edges. Conditions associated with the transitions determine at execution time which activity or activities should be executed next.

XPDL focuses on issues relevant to the distribution of work. Activity attribute specifies the resources required to perform an activity. This is an expression, evaluated at execution time, which determines the resource required. Activity attribute specifies the applications required to implement an activity. These concepts together support the notion of a resource (e.g. participant), in conjunction with an application, performing the activity.

The goal of XPDL is to store and exchange the process diagram. It allows one process design tool to write out the diagram, and another to read the diagram. It does not, however, guarantee the precise execution semantics.

WSCI (Web Service Choreography Interface) [6] was the first XML-based language that aims to provide a standard for specifying the overall collaboration between Web services providers and services users by describing messages exchanges that happen among the involving parties. WSCI is maintained and developed by the W3C.

WSCI describes the flow of messages exchanged by a Web Service participating in choreographed interactions with other services, describing the dynamic interface of the Web Service participating in a given message exchange. This means that WSCI describes how Web Service operations, e.g. defined in WSDL, can be choreographed in the context of a message exchange in which the Web Service participates. WSCI can be employed for describing both intra and inter organisational components and applications.

The goal of WSCI is to describe the observable behaviour of a Web Service by means of a message-flow oriented interface. This description enables developers, architects and tools to describe and compose a global view of the dynamics of the message exchange by understanding the interactions with the Web service. WSCI was built on top of WSDL. Actions are used to define basic requests and response messages. External services are invoked through Call.

CCML (Component Compatibility Markup Language) [7] has been developed to support a particular application, but a general purpose for it has been recognized. CCML allows systems of various kinds to obtain the various components of a facility that are compatible with those systems, even when different kinds of systems need variations of the same component.

A system requiring a facility requests it through its URI, and receives a URC describing the components of the facility. The system can then compare these descriptions with its own characteristics, eliminate components which would not be compatible, and download and install the remaining ones on the system: the amount downloaded is minimized, while being sufficient to provide the facility.

The original scenario for CCML is for use in an ALAN (Application Level Active Networking) node when it is instructed to download the code to run a proxy let on itself. The ALAN node understands what facilities it can provide to the proxylet, and the proxylet is expressed through CCML as a number of potential components, each with their own expectations of the available facilities..

6. Support of People-Driven Activities

The main problem related to the exploitation of service composition languages to describe learning processes is related to the lack of expressiveness about people driven activities. Differently from automated business processes, e-learning processes are strongly based on interactions with users with different roles (learner, teachers, tutors, learning providers, content providers, ecc.). So, to be actively exploited in learning processes, such languages have to be appropriately extended to involve people.

People can be involved in business processes as a special kind of implementation of an activity: a communication step which may be called people activity. From the user's perspective, the people activity is a task that is assigned to a user and requires the user to perform some action. Users are made aware of this assignment by a distribution mechanism that adds a work item to their task list. A work item denotes an assignment of a task to a user. Work items specify that a certain user is eligible to perform specific actions on a task. As well as being involved in tasks, people may be involved in a more simple communication step called notification, which is simply the transmission of information to an interested party. The most important difference between tasks and notifications is that a task holds up the process until it is completed.

Among the surveyed languages, only BPEL4WS has a feasible extension to support such scenarios named "the BPEL4WS Extension for People" or **BPEL4People** [8] that is defined in a way that it is layered on top of the BPEL language so that its features can be composed with the BPEL core features whenever needed. Such extension describes how the BPEL language needs to be extended in principle to cover user interactions with business processes.

The value of the proposal is that it can be used as a basis for a solution that covers different flavours of processes ranging from fully automated processes to processes supporting different user interactions patterns, including ad-hoc collaborations. This extension, combined with the existing BPEL features, will allow designing business processes that range from fully automated processes to processes that support different user interactions patterns.

BPEL4People covers several relationship between people. Among the others it analyzes the different ways that people interact with processes ("generic human roles") and how the process identifies the people to interact with ("people links"). People activities and processes have well-defined generic human roles defining what a person or a group of people resulting from a people query can do with them. This perception is independent of the actual business scenario the activity is used in, and is orthogonal to the organizational roles mentioned earlier.

6. Comparisons

The table below compares the available languages for services composition. From one side the best languages to describe e-learning processes seems to be OWL-S that is the only one able to support dynamic processes i.e. processes where actors are not defined a priori. From the other side the only language that can be extended to support people is BPEL4WS.

These considerations lead to the conclusion that, two partial solutions to describe e-learning processes on a Learning Grid are available starting from service composition languages, each one with some missing piece to cover all required functions:

– **BPEL4WS** extended with BPEL4People is useful to describe static e-learning processes but it lacks of dynamicity i.e. services must be bind at design time rather that at execution time so semantic extensions are needed to the language to overcome these limitations. It moreover has a further lack with respect to learning modelling languages being not explicitly thought to support learning activities (so there are no specific constructs for e-learning modelling).

– **OWL-S** is the only available semantic service composition language that is also able to provide dynamic functionalities. Conversely it cannot be easily used in e-learning given that, as BPEL4WS, doesn't explicitly support people interactions inside process models.

References

[1] Business Process Execution Language for Web Services version 1.1 http://www-128.ibm.com/developerworks/library/specification/ws-bpel/.

[2] Web Services Choreography Description Language Version 1.0 http://www.w3.org/TR/ws-cdl-10/.

[3] OWL-S http://www.w3.org/Submission/OWL-S/.

[4] Business Process Management Initiative http://www.bpmi.org/.

[5] XML Process Definition Language http://www.wfmc.org/standards/XPDL.htm.

[6] Web Service Choreography Interface http://www.w3.org/TR/wsci/.

[7] Steven Simpson, Paul Smith, Mark Banfield, David Hutchison. Component Compatibility for Heterogeneous active networking.

[8] BPEL4PEOPLE http://www-128.ibm.com/developerworks/webservices/library/specification/ws-bpel4people/.

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	BPEL4WS	WS-CDL	OWL-S	BPML	XPDL	WSCI	CCML
Abstraction level	Very high	High	High	Low	Low	High	High
Modeling the collaboration	Strong support	Strong support	Strong support	Indirect support	Indirect support	Strong support	Support
Modeling the execution	Strong support	No support	Strong support	Strong support	Strong support	No support	
Representation of the role	Weak support	Strong support	No support	No support	No support	Strong support	No support
Composability	Support	Strong support	Support	Strong support	Strong support		Support
Event handling	Strong support	No support	Strong support	Support	Support	Support	
Semantics support	No support	No support	Strong support	No support	No support	No support	
Support for Automated Composition	N	N	Y	N	N	N	N
Expressiveness	+	+	+	+	+	+	+
Defined Level of Abstraction	low	low	high	low	low	low	low
Semantic Constraints	-	-	+	-	-	-	-
Transaction and Compensation	Indirect support	Indirect support	Indirect support	Strong support	Strong support	Strong support	
Business agreement support	No support	No support	No support	No support	No support	No support	No support
Software vendor support	Many	No	Few	Few	Few	Few	
Tool support available	low	low	low	low	low	low	low

International Workshop on Collaborative System Design and Applications (CODS 2007)

In conjunction with the 7th International Conference on Intelligent Systems Design and Applications (ISDA'2007)

October 22-24, 2007 - Rio de Janeiro, BRAZIL

Workshop Chairs

Joan Manuel Marquès, Thanasis Daradoumis

Open University of Catalonia, Barcelona, Catalonia (Spain)

Supported And Co-Organized by:

- the Kaleidoscope Learning Grid SIG (http://grid.noe-kaleidoscope.org);
- the European FP6-IST-EU project grid4all (http://grid4all.eu);
- the MosaicLearning project (http://mosaic.gast.it.uc3m.es).

Scope and Objectives

Collaborative systems have caused a drastic change in the way people focus work and learning, especially at a distance. P2P and grid middleware and applications have opened new interesting possibilities for collaboration and learning. P2P allowed collaborators to share their own resources, whereby grid facilitated the access to remote resources not affordable locally as well as the increase of the participants' capacity to carry out specific tasks. Special emphasis is given to systems and applications that focus on participants that provide their own resources for the achievement of their goals. Another influencing issue concerns the analysis of both the systems performance and group interactions. The latter constitutes an important factor for group monitoring, support and performance.

This workshop aims at providing a forum for academic researchers, professionals and practitioners to exchange their experiences and their ideas about problems and solutions related to the design, development and use of groupware systems and applications. Researchers can report their ideas, models, designs and experiences on the proposed topics.

Topics of Interest

The manuscripts should closely reflect the final paper as it will appear in the Proceedings, which will be maximum 6 pages in IEEE double column format. Please format your paper, as described in the IEEE Computer Society Press. See details at main conference website http://www.isda07.eng.uerj.br.

The topics of interest include, but are not limited to:

- P2P and grid-based applications for collaboration/collaborative learning
- P2P and grid middleware for collaboration
- P2P and grid systems performance analysis
- Semantic grid and ontologies for collaboration/collaborative learning
- Collaborative applications and case studies
- Case studies and experiences in learning grid
- Nomadic and mobile collaborative work
- Multi-agent systems to support collaborative work
- Monitoring and analysis of group interactions
- Group awareness and scaffolding
- Self-properties in collaborative systems
- Distribution and replication of shared information

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Publication

The format of the initial submissions can be PDF. All papers should be submitted electronically via the Online Paper Submission System (http://www.isda07.eng.uerj.br/openconf/author/submit.php). The file of the final accepted papers should be in either Word or Latex. All accepted papers (presented orally or as a poster) with paid registration will be included in the Proceedings of ISDA'07. COSDA 2007 papers will be published by IEEE Computer Society. After the conference, authors of best papers will be invited to submit an extended version of their papers for possible inclusion in special issues of a selection of international journals. Submission implies the willingness of at least one of the authors to register and present the paper.

Important Dates

Paper Submission: April 16th, 2007

Notification of Acceptance: June 1st, 2007 Final Paper Submission: June 15th, 2007

Web Site: http://dpcs.uoc.edu/COSDA2007

When	What	Where
May 2-4, 2007	**GPC 2007 – Grid and Pervasive Computing in conjunction with the 1st International LAMS conference.** The aim of the round-table is to investigate opportunities and challenges of Pervasive Grids (PG). The round-table will bring together researchers from the Grid and Pervasive communities, who are active in the PG field, to discuss the definition of what is a PG. PG is motivated by the advances in Grid technologies and the proliferation of pervasive systems, and is leading to the emergence of a new generation of applications that use pervasive and ambient information as an integral part to manage, control, adapt and optimize. These include a range of application areas including crisis management, homeland security, personal healthcare, predicting and managing natural phenomenon, monitoring and managing engineering systems, optimizing business processes etc. www-lipn.univ-paris13.fr/GPC2007/	**Paris, France**
May 7-9, 2007	**OnLine Educa Madrid 2007** Over 500 high-level decision makers in higher education, business and government from more than 30 countries come together at Online Educa Madrid, making it the key networking venue in the rapidly expanding sector of e-learning in the Spanish-speaking world. http://www.online-educa-madrid.com/english/index.php	**Madrid, Spain**
May 7-11, 2007	**The 20th Open Grid Forum – OGF20** OGF20, presented by the Open Grid Forum and co-located with EGEE's 2nd User Forum, is the premier grid technologies event of 2007. At OGF20, the global Grid community will gather to develop Grid standards, showcase real-world applications, discuss large-scale grid infrastructure techniques and applications, workshop Enterprise and eSciences best practices and present business case studies and solutions. The OGF20 program features five days of engaging content including: Keynote and Plenary Presentations by Leading Grid Luminaries, Standards Group Sessions and BoFs, Enterprise Track Featuring Requirements Alignment, Best Practices and Adoptions Sessions, e-Science Track Featuring Software Developers Sessions and Workshops, 'Grids Means Business' Industry Program Showcasing Grid Adoption Benefits, Vendor Showcase and Exhibit Hall, Demonstration and Poster Session Area, Networking and Social Activities. OGF20 is hosted by UK e-Science and the University of Manchester. www.ogf.org/OGF20/events_ogf20.php/	**Manchester, UK**
June 5-8, 2007	**GridAsia 2007** The GridAsia program covers talks & panel discussions for industry, technical sessions, research workshops, and international collaboration sessions. There will also be a day of tutorials. At the conference grounds there will commercial & research exhibits, and poster sessions. www.ngp.org.sg/gridasia/2007/	**Singapore**
June 25-29, 2007	**ICDCS 2007 – the 27th International Conference on Distributed Computing Systems** ICDCS is an IEEE Computer Society sponsored premier conference with a wide coverage of topics in Distributed Computing. It has a long history of significant achievements and worldwide visibility. The conference provides a forum for engineers and scientists in academia, industry and government to present their latest research findings in any aspects of distributed and parallel computing. www.eecg.utoronto.ca/icdcs07/	**Toronto, Canada**

When	What	Where
July 7- 8, 2007	**SWEL 2007 – Ontologies and Semantic Web for e-Learning** This workshop will focus on Semantic Web based knowledge representation, Grid technologies, engineering approaches and methods for the design, development and experimentation of intelligent distributed educational systems. It will discuss issues related to the use of ontologies, Semantic Web standards, distributed processes and systems enabled by Grid technologies for learning content delivery, services and knowledge components specification, effective intelligent courseware construction, and learner modelling. SWEL 2007 is the fifth in the series. This edition has a special focus on service oriented Semantic Grid Architectures for e-Learning and is organized together with two Special Interest Groups of the European Network of Excellence Kaleidoscope: Artificial Intelligence and Education, and Learning Grid. http://compsci.wssu.edu/iis/swel	**California, USA**
July 9-13, 2007	**AIED 2007 – 13th International Conference on Artificial Intelligence in Education** The International Conference on Artificial Intelligence in Education (AIED) is in an ongoing series of biennial international conferences for top quality research in cognitive science and intelligent systems for educational computing applications. The conference thus provides opportunities for the cross-fertilization of information and ideas from researchers in the many fields that make up this interdisciplinary research area including: artificial intelligence, other areas of computer science, cognitive science, education, learning sciences, educational technology, psychology, philosophy, sociology, anthropology, linguistics, and the many domain-specific areas for which AIED systems have been designed and built. http://www.isi.edu/AIED2007	**Los Angeles, USA**
August 16-18, 2007	**GCC 2007 – the 6th International Conference on Grid and Cooperative Computing** The GCC conference has become one of the world-wide largest scientific events in the area of grid and cooperative computing. GCC2007 creates a stimulating forum for researchers and practitioners in grid and related fields, where people get together to exchange ideas, experiences and up-to-date technological advances. The main topics of interest include theory of grid computing, service-oriented foundation of grid computing, peer-to-peer architecture, novel grid architectures, grid middleware, resource organization and management for grid computing, resource virtualization for grid computing, grid workflow and service composition, grid usage models and portal tools, grid programming models and environments, engineering approaches to grid, semantic basis for grid computing. vega.ict.ac.cn/gcc2007	**Urumchi, Xinjiang, China**
August 27-28, 2007	**CoreGRID Symposium** The CoreGRID Network of Excellence is funded by the European Commission's 6th Framework Program. It aims at strengthening and advancing scientific and technological excellence in the area of Grid and peer-to-peer technologies. The network is operated as a European Research Laboratory and brings together a critical mass of well-established researchers from 41 institutions. The CoreGRID Symposium aims at being the premiere European event on Grid Computing for the dissemination of the results from European and member states initiatives as well as other international projects in Grid research and technologies. It is organized jointly with the Euro-Par 2007 conference. The CoreGRID Symposium will focus on all aspects of Grid computing including service infrastructures and as such will bring together participants from Research and Industry. www.coregrid.net/mambo/content/view/358/330	**IRISA, Rennes, France**

When	What	Where
September 17-18, 2007	**7th Annual Global LambdaGrid Workshop** GLIF, the Global Lambda Integrated Facility, is an international virtual organisation that promotes the paradigm of lambda networking. The GLIF participants are National Research and Education Networks, consortia and institutions working with lambdas. Participation in GLIF is open to any organisation that subscribes to the GLIF vision and can contribute to the GLIF actvities. The activities of GLIF are two-fold: the GLIF participants jointly make lambdas available as an integrated global facility for use by scientists and projects involved in data-intensive scientific research; GLIF brings together leading networking engineers worldwide, who exchange information to learn from each other's experiences, seek to establish best practice, work together to develop, test and implement new lambda networking technologies, middleware and applications, and generally collaborate to bring the technology forward. www.glif.is/meetings/2006/	**Prague, Czech Republic**
September 18-21, 2007	**NPC 2007 – International Conference on Network and Parallel Computing** The goal of IFIP International Conference on Network and Parallel Computing is to establish an international forum for researchers and practitioners to present their excellent ideas and experiences in all system fields of network and parallel computing. www.dlmu.edu.cn/npc2007/	**Dalian, China**
September 19-21, 2007	**Grid 2007** The Grid conference series is an annual international meeting that brings together a community of researchers, developers, practitioners, and users involved with Grid technology. The objective of the meeting is to serve as both the premier conference presenting best Grid research and a forum where new concepts can be introduced and explored. www.grid2007.org/	**Austin, TX, USA**