Virtual learning platforms and good practice

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Technological solutions for e-learning suits are presented: *The solutions are based on integration of informational resources in the global network as integration of information services. Concepts for the integration of resources and tools in Web are considered. Web service integration is addressed by the application of emerging standards and technologies. Examples of good practices for virtual learning platforms with Web services are discussed.*

Key words: *E-learning, Web services, Integration of Web technologies*

INTRODUCTION

The benefits of the e-learning Successive European Councils in Lisbon and Feira (2000), Stockholm (2001) and Barcelona (2002), have acknowledged lifelong learning as a key factor in ensuring economic competitiveness and prosperity, active citizenship, social cohesion and the fulfilment of individual personal aspirations. An important role for the implementation of such continuous strategy of education is dedicated to e-learning methodology.

Under the term “e-learning” it is noted the process of **education via Internet, network, or standalone computer.** Network-enabled transfer of skills and knowledge, e-learning refers to using electronic applications and processes to learn. E-learning applications and processes include Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM. Generally, the infrastructure of an e-learning system can be divided into a Learning Content Management System (LCMS) and a Learning Management System (LMS) [1].

E-learning encompasses content as well as educational tools and applications. E-learning is a method that makes educational content available on electronic media: CD-ROM, Internet, intranet, extranet, interactive TV and it is treated as different domains and technologies of learning.

General problem in e-learning is the different educational standards and their interoperability. The different technological solutions, operating systems, network technologies, developing environments raise problems about the e-content creation and usability [2].

The benefits of the e-learning technology address both sides in the educational process: teachers and students. The students can overcome the restrictions of the classical educational process for unity in time and space of the educational process. Thus, the e-learning technology offers freedom of the choice when and where to be educated. For the teachers the e-learning technology allows to integrate educational content, to design appropriate professionally prepared learning stuff, to cooperate on international level with the up to date pedagogical and professional achievements. A prerequisite for such possibilities in the e-learning functionality is to find the appropriate data in the virtual environment and to have common understanding about the formal description of the e-learning stuff. Thus an important problem in the e-learning content design and e-learning courses implementation is the integration of data, taken from the virtual environment [3].

To perform the integration two requirements have to be satisfied [4]:

- common presentation of the content;
- implementation of multisearch technology in virtual environment, which can retrieve appropriate information from different source of data.

The paper presents the standardization approaches for the development and technological solutions for integrating e-content from various sources. The integration is performed according to the paradigm of integration of info services. Appropriate technological solutions are explained. The integration of info services and data is regarded as the technological background for the implementation of reusable e-learning content in virtual labs and virtual education.

ANALYSIS OF THE e-LEARNING STANDARDS

There are several standards regarding learning technologies. Some of them are not so frequently used, so we collected the most common and important ones [5]:

- ISO/IEC Joint Technology Committee Subcommittee on Standards for Learning, Education, and Technology;
- IEEE Learning Technology Standards Committee (LTSC);
- Advanced Distributed Learning Initiative;
- IMS Global Learning Consortium;
- Aviation Industry CBT Committee (AICC);

International organizations and bodies are establishing and managing standards are shown in fig. 1.

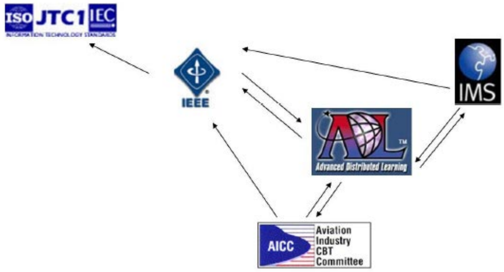

Fig. 1. Organizations managing standards for e-learning, copy from [5]

For the e-learning domain, relevant standards for information processing are:

- Metadata: Dublin Core; IMS (Global Learning Consorcium) Learning Resource Metadata; IEEE LOM.
- Courseware package format: SCORM Content Packaging; IMS Content Packaging.
- Framework-courseware communication: AICC CMI Data Model and API; SCORM Run Time Environment
- ERP integration: IMS Enterprise.
- Student data: IMS Learner Information Profile.
- Test modules: IMS Question & Test Interoperability (QTI)

The standards requirements address the question of common presentation of the e-learning content. The multi-search technologies are developed under the framework of GRID integration.

GRID ARCHITECTURE: THE TECHNOLOGICAL ENVIRONMENT FOR VIRTUAL E_LEARNING DESIGN

Grid computing is a form of distributed computing. There is a common management for the disparate resources: computer nodes, storage, applications and data spread across different locations. Grids are classified as either *compute* grids, which share common computational resources, or *data* grids, which support integration of data resources. These distinctions defines the hardware infrastructure needed to support the grid. GRID computing can be considered as a method for integrating a variety of systems connected together in the large network.

Web services allow GRIDs to be specified as services that can interoperate with each other. Wide range of GRID services, particularly those which perform information queries, can be developed as Web services. Web services are new phenomenon in the computer industry. They provide standard means of interoperating among different software applications, running on a variety of platforms and/or frameworks. Web services combine the best aspects of component-based development and the web. The Web services paradigm takes all the best features of the Service-Oriented Architecture (SOA) and combines it with the Web. Thus, it has been overcome the usual constraint of DCOM, CORBA or RMI and the Web services support web-based access, easy integration and service reusability.

GRID Computing and Web Services

The Grid computing is connected tightly with the concept of Web services. The definition of a service given according to [6] is “ an active program or software components in a given environment that provides and manages access to a resource that is essential for the function of other entities in the environment”. The services can perform functions ranging from simple requests to complicated business processes. Once a web service is deployed, other applications and services can discover and invoke the deployed service. The Web services are an effort to build a distributed computing platform for the web.

It is clear that there is overlap between the goals of grid computing and the benefits of SOA based on Web services. A service-oriented grid is constructed as a set of Web services, used both to virtualize resources and to provide other grid functions, fig.2.

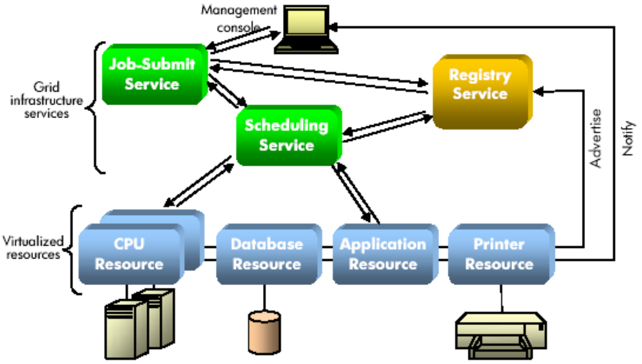

Fig.2 Service oriented GRID, copy from [6]

On Fig.2 a single console is used to submit jobs and to manage the grid’s resources. The console’s management software contacts the registry service to discover the grid resources, and then contacts each service to request data. The scheduler locates the service to determine availability. If sufficient resources are available, the scheduler selects the best available set of services and passes their details to the application service. The last invokes and executes the selected services.

Technologies

Virtual environment’s design involves multiple innovative technologies. Web Service Description Language (WSDL), developed by World-Wide Web consortium (W3C), is the main standard for information interchange and remote access to applications. The XML format of data presentation is a natural extension of the HTML coding. The communication and messaging between XML results sets is performed by the protocol SOAP. SOAP (Simple Object Access Protocol) is a XML-based messaging protocol that contains an envelope, header, and body, designed to exchange information in a decentralized, distributed environment. The UDDI (Universal Description, Discovery, and Integration) is an XML-based Web Services standard is developed to design a public registry of information about the info services and their functionalities.

EXAMPLES OF E_LEARNING LABS

Here and illustration of e-learning platforms, based on grid technologies and Web service search and integration are presented.

Biology Labs On-Line - www.biologylabsonline.com [7]. Biology Labs On-Line (BLOL) offers interactive biology simulations and exercises designed for high school students. These labs allow students to conduct virtual experiments that would not be feasible in a school due to cost, time-constraints, or safety concerns. The lab topically supports e-learning for the fields of biology, genetics, cell biology, and ecology. BLOL services are web-based, easily accessible, vertically scaleable and modular.

Web based teleoperated Virtual Laboratories (Web Labs) - [8] , fig.3. This e-learning platform consists of two parts. The client runs a web browser to open a web page from the server. On the front end is incorporated a user friendly interface which allows the user to access simulation, testing and make experiments with a virtual model.

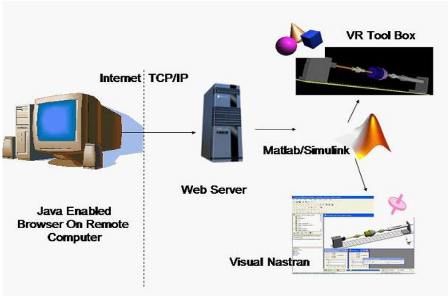

Fig.3. Teleoperated Web Lab, copy from [8]

The server runs the interface scripts, which communicates with MATLAB and generates the virtual services using the Virtual Reality Toolbox (VRT). Thus, on the client's side only a browser is used. On the server side standard HTML with Java components and VRT plug-in for the interactive features are exploited.

Virtual Chemistry Laboratory, Chemistry Department, University of Oxford [9]. This platform offers a set of resources to assist staff to teach small group of students. The available resources are: **Case** studies; **Online** bibliography; **Reflective Tools** - questionnaires for identifying those areas of teaching and learning that the students want to enhance; **Publications** – additional references for the study domain; **"Ask questions"** – questions to the teacher.

A list with god practices in deployment of e-learning systems and tools are available at:

- Universitat Konstanz, Advanaced Virtual Laboratory
- John Hopkins University, Virtual laboratory
- Universitat Bochum, Virtual Control Lab;
- University of Oregon, Physics applets
- Carnegie Mellon Universitat, Virtual Chemistry Laboratory

- МГТУ имени Баумана, Автоматизированный Лабораторный Практикум с Удаленным Доступом
- TU-Sofia, Virtual Laboratory for Measurments in Electronics
- TU-Ruse, Virtual e-learning platform ELSE.

CONCLUSIONS

The concept of web service is powerful for the integration of e-learning content. It develops an open space of info services in the global network and integration of informational resources is achieved. The technology stack applied for the integration of info services is restricted: SOAP communications and XML data presentation; WSDL description of the web services; UDDI for the repositories definition and implementation. The concept of GRID computing provides the ideal framework for developing virtual collaborative e-learning environments. Web services allow GRIDs to be specified as integrated services that can interoperate with each other. Thus, variety information resources are put together into a virtual supercomputing system. Web services and a service-oriented style of architecture are seen as the basis for new distributed e-learning applications and e-learning system management. The paper performs and overview of available technological solutions, which can be applied in the development and the deployment of e-learning facilities, systems and virtual laboratories.

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