DIOGENE: A TRAINING WEB BROKER FOR ICT PROFESSIONALS

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The purpose of this paper is to describe the work in progress related to the design, the implementation and the evaluation of an innovative e-learning platform for ICT individual training in the framework of an EC funded project named Diogene. The present e-learning solution includes several state-of-the-art technologies and methodologies such as: metadata and ontologies for knowledge manipulation, fuzzy learner modelling, intelligent course tailoring, co-operative and online training support. The proposed solution is based on the distribution of working tasks among content provider services, content discovery services, content brokering services, training services, curriculum vitae searching services and collaboration services.

1 Introduction

It is a well-known fact that many corporations would like to increase the global productivity of their production processes using e-Learning techniques as an alternative way to improve the effectiveness of their human resources. This general comment is also applicable to the SME's in the ITC market sector, in general lacking adequate personnel training.
The mission of Diogene is to innovate the vocational and post-degree training in the ICT field making it more flexible and effective through the advanced use of the Information Technology. Particular interest is placed in the application of methodologies for distance learning and in the evaluation of their impact.
The activity of production, experimentation and research of Diogene focus in conjugating demands and didactic objectives of free-lance teachers, learning material providers and learners through well defined training strategies analysing, defining, planning and appraising the most suitable methodologies to support them.
The paper is organised as follows: the Diogene project will be briefly described and its main features introduced (section 2). A sketch of the system architecture will be then presented (section 3) and some conclusions (section 4) and references will follow.

2 What's Diogene

Diogene is an EC funded project under the 5th Framework Programme whose objective is to design, implement and evaluate with real users an innovative training Web brokering environment for ICT individual training (but based upon a domain-independent platform) able to support learners during the whole cycle of the training, from the definition of Learning Objectives to the assessment of results through the construction of custom self-adaptive courses.

The system will use several state-of-the-art technologies such as: metadata and ontologies for knowledge manipulation, fuzzy learner modelling, intelligent course tailoring, co-operative and online training support. Besides, it will include a set of innovative features such as: dynamic learning strategies, Semantic Web openness, Web services for Learning Object handling and property rights management, Curriculum Vitae generation and searching facilities, free-lance teachers support, assisted Learning Objectives definition.

The system will be accessible through the Web exploiting an ASP methodology. Once a learner accesses Diogene e-learning system, he/she can select a particular set of topics from an ontology of arguments and let the system arrange a personalised self-adaptive course about chosen topics (personalisation will be based on Learning Preferences).

The Diogene e-learning platform includes eight courses ("Object-Oriented Analysis and Design based on UML", "XML", "Business Process Modelling", "Building COTS Based Systems", "Increasing Organizational Performance with the Balanced IT Scorecard", "Information Security for SMEs", "Dynamic web pages" and "Digital images") in four languages (English, Spanish, French and Bulgarian). The following paragraphs describe briefly its innovative features with respect to commercial e-learning platforms presently available on the scene.

2.1 Metadata and Ontologies for Knowledge Management

All Diogene learning material is organised in Learning Objects indexed through IMS compliant metadata in order to let the system know what each one of them is about and how it can be used during the learning process.
To provide, also, information about Learning Objects relations and interdependency, Diogene applies ontologies allowing to design abstract, simplified views of training domains. Within Diogene, ontologies are used to define and relate concepts of a training domain with four kinds of relations: (is_part_of, requires and suggested order) and, also, to link concepts to Learning Objects.

2.2 Semantic Web Openness

A new characteristic of Diogene e-learning system will be its openness to the new Semantic Web paradigm. A key idea behind the project is, in fact, to not only rely upon ad-hoc generated learning material (i.e. high quality Learning Objects) but also to exploit the power given by the Web of the next generation to find useful and freeware learning material.

2.3 Web Services for Learning Object Handling

High quality learning material to be used in Diogene e-learning system will be organised by content providers in several Learning Objects and maintained on their own Web servers. This means that such material will be never imported on the main Diogene site avoiding, in this way, any property right related problem and giving content providers, in the same time, the possibility to manage contents (re-organise, update, delete) locally and not through complex HTTP or FTP based remote interfaces.

2.4 Intelligent Course Tailoring

A Diogene course is composed by an user selected set of learning goals (key concepts that the learner has to learn) and by a learning path (a sequence of Learning Objects that has to be used to provide, to a specific learner, all necessary knowledge to fully understand chosen goals). Different learners can require different paths to learn the same goals depending on their Student Models. For this reason, Diogene provides an automatic curriculum generation procedure: the learner can choose what to learn (goals) and let the system organise a personalised learning path for him. Such path can change dynamically during the learning process adapting to learner needs in relation to learner performed activities.

2.5 Curriculum Vitae Search Engine

Information about Diogene learner models will be exportable in a standard format (PAI, LIP, etc.) in order to allow the possibility to create a standard CV of the learner to be published, with respect to privacy requirements. Such curriculum will include information about: identification of biographic data, qualifications, learning related activities, competencies, language capabilities and preferences.

2.6 Free-Lance Teachers Support

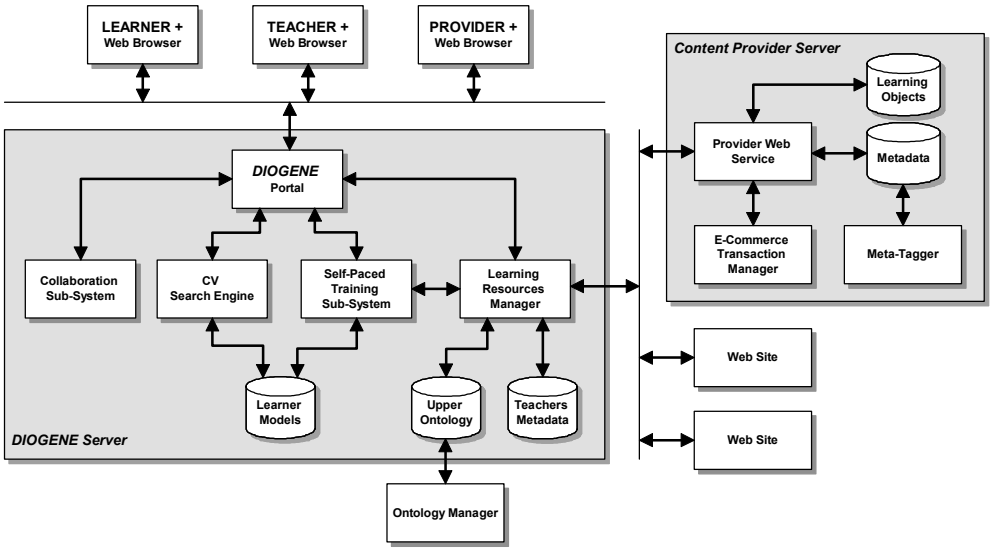
Not only learning contents will be indexed through Metadata but also other learning resources such as teachers will be defined and described in that way. Free-lance teachers will have, in fact, the possibility to subscribe Diogene and to describe (in a formal way) their professional abilities.

3 Diogene Architecture

Initially, when we proposed Diogene, we sketched a possible architecture for the whole Diogene platform. Such an architecture was composed essentially of two different typologies of servers:

- **Diogene Servers** constituting the users Web access point to Diogene providing all functions related to course management and delivery, content management and searching, collaboration, CV maintenance and free-lance tutors handling;
- **Content Provider Servers** able to provide access to remotely hosted content, to search content in the local base, to give access to it basing on access rights and to perform e-commerce transactions between users and providers in order to pay for such access rights.

The Diogene foreseen architecture can be depicted in the following figure:

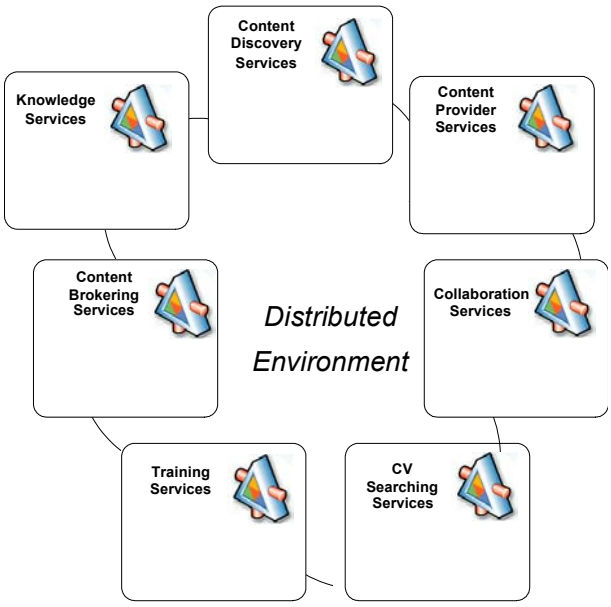


The foreseen architecture was well structured and presents some preliminary idea of distributed computation. It was though in 2001 when Web Services were still an immature technology and the idea was to explore this field by providing remote services handling high quality learning content accessible from many different installations of Diogene Servers. Nevertheless, such an architecture, seen at two years from its conception, presents some limitation.

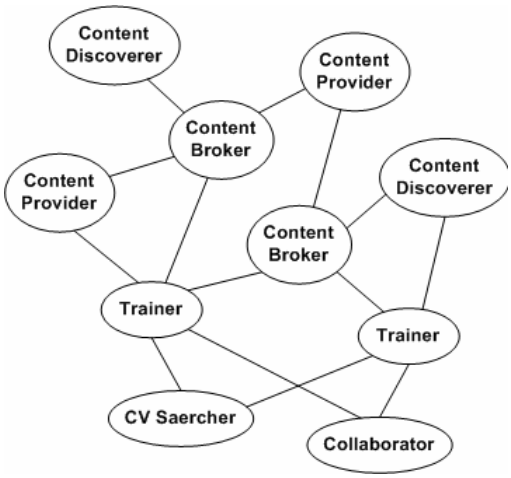
First of all it doesn't allow the collaboration between different installation of Diogene Servers: users of one servers can't collaborate with users of other servers, free-lance teacher subscribed to one server can't be seen by other servers and need to re-subscribe on them, CV search engines can find people only on one installation of the server so enterprises interested in hiring new staff have to search many times on different search engines related to different installations of the Diogene Server.

The production of high quality learning content in such environment should result in a very difficult task because the ontologies are maintained by single installations of the Diogene Server rather than in a centralised repository so providers have to know the ontologies of all their customers.

By organising the system in this way, finally, every Diogene Server must know all Content Provider Services from which to take content. But there can be a lot of Content Provider Servers and they can born and disappear very quickly so it would be difficult to maintain the provider list updated.
For these reasons we decided to give to Diogene a more evident distributed characterisation by exploiting a model very similar to that of Virtual Organisations and strongly based on the use of Web Services. The architecture we have in mind, already presented can be sketched as follows.



The meaning of shown Diogene services is described briefly below and will be deepened and formalised in the following part of this document.
The following figure depicts possible interactions between multiple instances of Diogene services hosted by different organisations. They will constitute the Diogene Network as we will see later.



- **Content Provider Services**. They provide search and retrieval functions on the local repository via metadata-based queries.
- **Content Discovery Services**. They are able to extract training content directly from the Web of the present and of the future generation (Semantic Web). Through a keyword-based text categorisation algorithm they are able, where absent, to automatically extract metadata from textual Learning Objects and to link them to ontology concepts. Through a mixed approach based on keyword and ontologies, moreover, they are able to bypass compatibility problems between different ontological representations of the same domain.
- **Content Brokering Services**. They are brokers of training content. They collaborate with Content Provider and Discovery Services in order to find the right provider with the right content.
- **Training Services**. They are responsible for the delivery of courses and for the provision of course management and execution functions. They deal, moreover, with "intelligent" training functions like learner modelling, course tailoring, assisted objective definition and learning strategies upgrading. They don't maintain any local training content but strictly interact with Content Brokering Services or directly with Content Discovery and Provider Services to obtain and combine Learning Objects.

- **CV Searching Services**. They provide search engine capabilities in order to let third parties interested to hire certified staff to find qualified professional (with respect to privacy requirements). They will maintain, moreover, statistics of received requests in order to rank required competencies.
- **Collaboration Services**. They will support social interactions, mentoring and information exchange by providing users a set of collaborative synchronous and asynchronous facilities. They will be able to automatically arrange groups among users of registered Training Services by individuating and grouping learners with similar needs and/or profiles.

4 Conclusions

In this paper we described the e-learning platform developed under the framework of an EC funded project named Diogene, its innovative features, its architecture and the evolution of such architecture toward a distributed services paradigm.
The Diogene project started in April 2002 and will end in September 2004. The architecture design phase of Diogene is running toward its end and the implementation phase is recently started. A first prototype of the Diogene e-learning platform will be available in March 2004.

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