ABSTRACT

Grids are increasingly being used in applications, one of which is e-learning. As most of business and academic institutions (universities) and training centres around the world have adopted this technology in order to create, deliver and manage their learning materials through the Web, the subject has become the focus of investigate. Still, collaboration between these institutions and centres is limited. Existing technologies such as grid, Web services and agents are promising better results. In this article the authors support building our architecture Regionally Distributed Architecture for Dynamic e-Learning Environment (RDADeLE) by combining those technologies via Java Agent DEvelopment Framework (JADE). By describing these agents in details, they prove that agents can be implemented to work well to extend the autonomy and interoperability for learning objects as data grid. [Article copies are available for purchase from InfoSci-on-Demand.com]

Keywords: Data Grid; Regional Grid; Multi-Agent System (MAS); JADE; E-Learning; Intelligent; Autonomous; Distributed data grid; Learning Objects (LO); Search

INTRODUCTION

E-learning has been increasingly used by both academic institutions and businesses for learning and training activities. Various types of e-learning platforms and tools have been introduced in many different education institutions and private training centres. Many technologies include web services (Rodriguez, Anido-Rifon, & Iglesias, 2003), grid computing and data grid technology (Yang & Ho, 2005) and agent technology (Sousa, Silva, Teixeira, & Filho, 2006) have been integrated into e-learning environments to enhance the architecture.

Web services have emerged as a paradigm of distributed computing, and have been proposed as an intermediary framework for the integration of standard compliant e-learning platforms in order to eventually embrace advantage of the benefits offered by their technology (Rodriguez et al., 2003).

Data grid technology is another supporting technology for e-learning services in order to make learning materials such as Learning Objects (LO) sharable by learners in different
sites (Yang & Ho, 2005). In data grid, replication services can be used to enhance the performance in reliability, scalability and fault tolerance (Chervenak et al., n.d.) (Guy, Kunszt, Laure, Stockinger, & Stockinger, Edinburgh, Scotland, July 2002.). Agents can provide both useful abstraction at data grid environment and very dynamic and robust services. Using the agents’ essential powers is strongly recommended in grid environments.

MAG (Mobile Agents Technology for Grid Computing Environments) is developed by Federal University of Maranhão, Brazil. The aim of the project is developing free software infrastructure based on mobile agents technology that allows the resolution of computationally intensive problems in computer grids. MagCat extends MAG to handle applications that manipulates huge amount of data. Although the multi-agent system MagCat has its search agent (known as SearchAgent) which is responsible for performing queries in distributed metadata repositories, this agent does not analyse the result of its search (Sousa et al., 2006).

These technologies have not been adopted cooperatively and collaboratively to support e-learning services. Agent and data grid architectures seem different from each other. As a matter of fact, we can learn from one in order to improve the other (Thompson, 2004). E-learning services are composed of many components which are part of distributed systems. These components and the system as a whole are designed to be cooperative. Grid and agent communities are pursuing the development of such distributed systems (Foster, Jennings, & Kesselman, 2004). In our architecture, we intend to support e-learning services using these technologies.

The organisation of the article is as follows. First, in section II we present a background which includes grid computing and agent and information management. In section III we present an overview of our architecture Regionally Distributed Architecture for Dynamic e-Learning Environment (RDADeLE). This includes descriptions of architecture components and regional grid structure. In section IV, we introduce agents’ specifications. This includes MAS-based e-learning, agent architecture, and agents formalisation. In section V, we introduce the implementation which includes the platform, registries and multi-agent systems, and case study. Finally, in section VI we conclude the article and future work.

BACKGROUND

The following is background about the technologies mentioned in the previous section in order to present an introduction and definitions. Those technologies are adopted to be embedded in our model to produce a dynamic e-learning environment. Those technologies include grid computing, agent and its role in data management, and finally learning objects.

Grid Computing

Grid computing provides an environment where a widely distributed scientific and academic community shares its resources across different administrative and organisational domains. The purpose of grid computing is to solve large-scale computing and data-intensive applications and collaborate in a wide variety of disciplines. Grid computing, therefore, enables the creation of a virtual environment which facilitates physical resources across different administrative domains in order to be beneficial; these resources are then abstracted into computing or storage units that can be transparently accessed and shared by large numbers of remote users.

Data grid is concerned with massive datasets and remotely separated storage units organised in a virtual environment. As a result of the increase of learning materials (Learning objects) and the need for huge masses of information to be archived and shared among academic institutions and training centres, data grids become an indispensable technology in learning fields. E-learning platforms and systems have been adopted, developed and pub-
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