Chapter III
Service-Based Grid Architectures to Support the Virtualization of Learning Technology Systems

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ABSTRACT

E-Learning has been a topic of increasing interest in recent years, due mainly to the fact that content and tool support can now be offered at a widely affordable level. As a result, many e-learning platforms and systems have been developed. Client-server, peer-to-peer and recently Web services architectures often form the basis. Drawbacks of these architectures are often their limitations in terms of scalability and the availability and distribution of resources. This chapter investigates grid architectures in the context of e-learning as a proposed answer for this problem. The principles and technologies of grid architectures are discussed and illustrated using learning technology scenarios and systems.

INTRODUCTION

Many organizations have embraced e-learning as the answer to the need to constantly educate and train students and employees. E-learning offers a solution to this dilemma by making courses and content available when and where needed. These organizations attempt to find solutions in order to implement e-learning services by using e-learning portals, virtual classrooms, Web applications

and many others technologies. Globalization is one factor that requires organizations to address learning and training in heterogeneous environments, crossing language, culture, and technology boundaries. Education providers such as universities are recently also under pressure to collaborate on an international level. The types of e-learning solutions that meet these needs arising from these trends require flexible architectural platforms.

Current e-learning solutions for distributed learning and training are often based on client-server or peer-to-peer architectures, recently more and more involving the Web services platform. Drawbacks of these architectures are often their limitations in terms of scalability of the system architecture and the availability and distribution of shared resources in federated, heterogeneous systems (Pankratius & Vossen, 2003). This chapter investigates grid architectures in the context of e-learning as a proposed answer for this problem. In grid computing, computing becomes pervasive and individual users and applications access resources with little or no knowledge of where those resources are located or what the underlying platform is. Its key values lie in the underlying distributed computing infrastructure technologies in support of cross-organizational application and resource sharing. Virtualization across technologies, platforms, and organizations is the central idea behind grid computing (Foster, Kesselman, & Tuecke, 2001). Grid architectures and grid computing provide benefits addressing the shortcoming of current architectural solutions in this context.

This chapter investigates the use of grid computing and grid architectures in the context of e-learning. It focuses on the implementation of grids from using platform-specific architectures, in particular the adaptation of grids to service-oriented architectures based on Web services. The objectives are:

- To address the developers of infrastructure technologies, who need an understanding of the underlying platform of e-learning applications, ranging from Web services at the bottom to grid toolkits at the highest platform layer.
- To address developers of learning solutions, who need an understanding of how e-learning scenarios are mapped onto supporting architectures (i.e., implementing these scenarios within the capabilities and constraints of the platform).

We discuss the specific benefits, but also difficulties, of using Web services as the underlying distribution platform technology for e-learning grids, having in particular the non-experts in mind as an audience. Understanding the platform infrastructure on which grid applications run is essential for anyone attempting to implement such a system. A number of learning and training scenarios, stemming from the outlined needs of globalized learning and training, are discussed in terms of their implementation using grid technology.

We present three scenarios illustrating the benefits of grid-based learning technology systems:

- We present the grid-based learning object repository infrastructure (GLORIS) system prototype in our first scenario on distributed resource sharing to illustrate the grid architecture implications for learning technology systems. GLORIS is a broker component that connects content management, learning object repository and delivery components of a learning technology system.
- The second scenario illustrates distributed execution of learning activities using a virtual lab system for illustration. The grid architecture allows the lab resources to be used interactively by geographically distributed learners.
- The third scenario addresses distributed collaboration and analyses. Grid architectures