Chapter 5
The Grid as a Virtual Enterprise Enabler

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ABSTRACT

Modern information systems are extending the traditional boundaries of organizations incorporating external recourses in the form of data and services. The need to support increasing client demands has led to dynamic and more complex business processes. Complex workflows in networked organizations are much more difficult to manage since traditional approaches are not suited for distributed environments. Service-Oriented approaches in the form of Web or Grid services bear the potential of increased performance and flexibility. In this work, we discuss the use of a relatively new computing paradigm that leverages distributed service-oriented business models: the Grid. We discuss how the Grid can facilitate efficient intra-business processes in highly dynamic virtual enterprises and present a high level architecture for managing complexity of business functions using Grid services.

INTRODUCTION

Future trends in Information Systems technology suggest that systems will be designed and driven by business and enterprise knowledge models supported by repeatable work processes and managed in open layered architectures. New business models favor the formation of dynamic alliances expanding the borders of the traditional enterprise to include resources (people, knowledge, processes) from other participants (Nilsson, 2005). In order to efficiently utilize networked business models, new paradigms that significantly increase connectivity, communication, coordination and collaboration must be adopted. Cooperation introduces communication in the form of information transfer between elements through data links (dataflow model) and method invocation (workflow model). Service-based operations will support the process enaction and automation inside and outside a company.

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Industrial R&D are in the business to develop new processes and services with an increasing use of computing power, the need to analyze large volumes of data, and a required synergy from geographically distributed groups. Company and site wise integration is an essential part behind the vision of sustainable enterprises. Grids can be employed to transform conventional manufacturing sites into virtual sites easy to manage, monitor, and understand. Grids can further support the development of novel products and services with means of visualization, better management of computer experiments, and decision support with the analysis and processing of data. The integration of industrial functions will take the form of virtual spaces for communication, management, and for designing computing environments that address complex industrial problems. Such problems account for industrial challenges in operations (scheduling, tactical and strategic planning, supply chain management and control), design (synthesis, integrated design, distributed computing experiments), and integrated workflow environments in R&D groups, operators and maintenance teams.

Grid Computing, or simply the Grid, is a new computing paradigm that enables access to distributed and heterogeneous computational resources (CPU cycles, storage, services, sensors, data) in a transparent, simple and on-demand way (Foster et al., 2001; Foster & Kesselman 2003). The basic vision of the Grid resembles that of the Electric Grid where resources (electric power) are offered to the users transparently, efficiently and cost effectively; the final goal is to enable the provision of computational resources as commodities. To enable this vision, several technologies have already been made available: coordination and virtualization of resources, management of heterogeneous resources, security, autonomy and others. Recent advances in Grid frameworks enable its application in many areas, especially e-science, enterprise computing, e-Commerce and e-learning. The use of Grid technology among large companies is not widespread, although several examples of efficient use are available: Wachovia is using Grid technology to speed up financial transaction processing (Wells, 2008), Shell Petroleum bases a part of its information workflow infrastructure on the Grid (Weidong et al., 2006) and Ford Motors performs fast 'what-if analysis' on Grid engine software.

Currently there is a lack of agreement among researchers on what a Grid really is (Stockinger, 2007). In the last few years, the Grid concept has borrowed some characteristics of the Service-Oriented model in order to be able to be applied to Business needs. The definition of Grid services that are actually extended web services is such a move. The Grid was supposed to have a profound impact on the way computing is used. Such a revolution did not take place since the success of this new technology relies not only on the definition of the appropriate technological standards but user acceptance as well. The latter depends on a combination of social, cultural, legal, ethical, organizational, political and economic parameters (Goyal & Lawande, 2007). However, the vision of using the Grid's Service-Oriented Architecture for the implementation of intra-enterprise communication has not died.

In this article the initial ideas presented in (Votis et al., 2004) are extended in order to present a Grid architecture for the implementation of large information systems that encompass several participants. We discuss how the Grid is emerging as a major enabler for networked organizations and relating technologies are used to support complex information systems. A three layered architecture is presented that uses workflow engines and Grid services to support the execution of complex business processes. A more holistic view of business infrastructures is supported where services are metadata enabled and ontologically principled. An Enterprise Resource Planning application is used to highlight in more detail the specific aspects of such a schema.