

Chapter 13

Adaptive Grid Services

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ABSTRACT

The chapter aims to explore the implementation of grid services and defines a theoretical approach to a development framework which would enable the creation of agile services. At present, services are written with specific goals in mind which may support the majority of users of the service. However if the requirements of the users change, or there exist users who require a slightly alternative form of the service, then either multiple services must be orchestrated to provide the required functionality to the users, or a new service must be implemented to address any gaps in functionality. An alternative solution is presented in the chapter which adopts aspect-oriented programming as a core component in the framework. By utilizing this paradigm, it becomes possible to develop services that are agile; capable of combining the capabilities required to support requests being submitted to the grid node dependent upon individual needs. To facilitate this mechanism, a pool of service components must be created from which the weaving component of the framework can select, via semantic discovery, the most appropriate.

INTRODUCTION

Teleworking is a phenomenon by which employees are given freedom to work from any location and at any time by using Information and Communication Technology (ICT). With its undoubted advantages,

teleworking has found itself a niche market in a fast moving and dynamic e-business. In the United Kingdom, British Telecom reckons that there are about two million people working at home and that more than a quarter of them are teleworkers (iVillage, unknown). The model commonly adopted is for employees to work in virtual offices, forming virtual communities, and collaborating

DOI: 10.4018/978-1-61350-113-9.ch013

through distributed toolsets. Research in the field considers the support of teleworking through the development of software or middleware solutions on a distributed system (Dangelmaier et al., 1997; Sugawara et al., 2003).

The field of teleworking is one which can be closely linked to the development of virtual environments. The aim of these environments is to create widely distributed applications to support the communication and collaboration of workers in a Virtual Office or Virtual Community. In this chapter, the similarities between these fields and the potential offered by grid computing are explored. We also examine some of the potential limitations in the way that grid services are currently developed, and propose an alternative strategy making use of Aspect Oriented Programming (AOP) to enable the creation of fully dynamic services to support the needs of an agile user base.

Whilst the development of distributed systems has evolved rapidly over recent years (Coulouris et al., 2005), there remain limitations related to individual nodes in a system. These relate to the hardware being used such as the processors and hard disks (Abbas, 2004). Following recent work in the field which explores the use of Web Services to support teleworking (Braun & Schill, 2002), a potential solution to these limitations for teleworking appears to lie in grid computing. There appears to be much in common with the field of grid computing which itself aims to support distributed resources and users in Virtual Organisations (VOs) through a service-oriented architecture.

The objectives of this chapter are to explore the limitations in Service-Oriented Architectures (SOA). Specifically, the chapter will focus on the creation of dynamic services to support users in Virtual Organizations (VOs) who may be highly diverse in their needs. The key aspects to be considered include the identification of suitable service components to form the functionality of the service, and also the construction of a service using those identified components.

BACKGROUND

Teleworking and Grid Computing

The field of grid computing has been evolving over the past decade or so, having been derived from the notion of electricity grids; that is, on-demand facilities that are distributed and adaptable to the user needs. Two key areas in which grid computing can be closely aligned with concepts derived for teleworking are

The dynamic nature of a grid means that services and resources can be added or removed as required. This aligns well with the agile and dynamic nature of a teleworking environment.

The notion of Virtual Organizations which relate physically disparate resources and users together and involves issues of trust, authorization and authentication to be successfully implemented. The relationship with teleworking lies in the concept of forming a community that will logically join geographically separated resources.

The technology currently employed to implement grid-based solutions is now mature. Open Grid Services Architecture (OGSA) uses a common representation for storage and computational resources, networks, programs, and so on (Joseph & Fellenstein, 2004). All are treated as *services*—network-enabled entities providing facilities through the exchange of messages (Foster et al., 2002a). Grid toolkits based on OGSA, such as Globus (Globus Alliance, 2005), are aligned with web service standards. In particular, this features the embodiment of the Web Services Resources Framework (WSRF) (Globus Alliance, 2005; Sotomayor & Childers, 2006). As such, these toolkits offer an ideal opportunity in which to develop teleworking tools using an architecture which offers a stable framework to support a SOA based on a computing grid. Indeed, a proposed architecture for using a SOA based on Web Services to support teleworking has identified a number of categories where teleworking could be facilitated (Braun & Schill, 2002). The

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