Chapter 4.3
Making Scientific Applications on the Grid Reliable Through Flexibility Approaches Borrowed from Service Compositions

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ABSTRACT

The current trend in Service Oriented Computing (SOC) is to enable support for new delivery models of software and applications. These endeavours impose requirements on the resources and services used, on the way applications are created and on the QoS characteristics of the applications and the supporting infrastructure. Scientific applications on the other hand require improved robustness and reliability of the supporting Grid infrastructures where resources appear and disappear constantly. Enabling business model like Software as a Service (SaaS), Infrastructure as a Service (IaaS), and guaranteeing reliability of Grid infrastructures are requirements that both business and scientific application nowadays impose. The convergence of existing approaches from SOC and Grid Computing is therefore an obvious need. In this work we give an overview of the state-of-the-art of the overlapping research done in the area of SOC and Grid computing with respect to meeting the requirements of the applications in these two areas. We show that the requirements of business applications that already exploit service-oriented architectures (SOA) and the scientific application utilizing Grid infrastructures overlap. Due to the limited extent of cooperation between the two research communities the research results are either overlapping or diverging in spite of the similarities in requirements. Notably, some of the techniques developed in each area are needed but still missing in the other area and vice versa. We argue therefore that in order to enable an enterprise-strength service-oriented infrastructure one needs to combine and leverage the

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existing Grid and Service middleware in terms of architectures and implementations. We call such an infrastructure the Business Grid. Based on the Business Grid vision we focus in this work on presenting how reliability and robustness of the Business Grid can be improved by employing approaches for flexibility of service compositions. An overview and assessment of these approaches are presented together with recommendations for use. Based on the assumption that Grid services are Web services, these approaches can be utilized to improve the reliability of the scientific applications thus drawing on the advantages flexible workflows provide. This way we improve the robustness of scientific applications by making them flexible and hence improve the features of business applications that employ Grid resources and Grid service compositions to realize the SaaS, IaaS etc. delivery models.

1. INTRODUCTION

Today, Grid infrastructures are mainly used for scientific computations dealing with considerable amounts of (experimental) data and performing extensive, time-consuming computing tasks. Usually, the hardware and software resources used to run the computations are out of the control of the application owners. The resources used for the computations may be used only for a concrete time period and may appear and disappear in an unpredictable fashion. It has been documented in research publications that the major challenge to be overcome on the Grid is its reliability (Fox & Gannon, 2006).

This book chapter will focus on approaches for making the Grid more reliable. We argue that Grid applications can be made more reliable through making them more flexible. We will present approaches towards flexibility of applications on the Grid. An objective of this work is to show that approaches and infrastructure created by the SOA community can be used for the benefit of the Grid community. Moreover, since approaches from the Grid are needed on the SOA infrastructures, such leverage of concepts and techniques will allow for a mutual amplification of these benefits for both communities. The major assumption in the chapter is that Grid and Web Service technologies can be combined to enable more reliable infrastructure for both business and scientific applications. We argue that only through this combination an infrastructure for supporting both business and scientific applications can be created, which fosters leverage of existing technologies, mechanisms and techniques, and can provide added value to the users in both domains. We are convinced that the two domains have a lot to leverage and learn from each other and employ the research results to the advantage of both communities.

The chapter will start with an overview of the SOA (Service Oriented Architecture) paradigm, its role model and the operations an SOA infrastructure supports. We also present the Web Service technology as the only available implementation of the SOA paradigm. It is only through service composition that complex business and scientific computations can be enabled, therefore we present an overview of the process-based approach for service composition known from the field of Business Process Management (BPM). In particular, we identify the Business Process Execution Language (BPEL) as the one with the greatest potential to facilitate the creation of complex applications for business and scientific computations. We present the architecture of a (Web) Service Middleware, also known as the Bus or the Enterprise Service Bus (ESB).

Afterwards we shift the focus onto Grid services and existing technologies, whereas we pay the greatest attention to the Web Service Resource Framework (WSRF), which is the latest technology for Gird services and represents the convergence of research efforts of the Grid and SOA communities. WSRF is a framework that allows for representing stateful resources