

Chapter 14

Enhancing the Grid with Multi-Agent and Semantic Capabilities

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ABSTRACT

Addressing the requirements of academic end users, the Grid paradigm and its underlying technologies was in past developed and evolved neglecting the needs of potential business end users. Nowadays the trend changed towards the use of Grid technologies within electronic business (e-Business) which at the same time requires adapting existing technologies to allow for more flexible, intelligent and reliable support for business stakeholders. The BREIN project was the first one integrating two so far parallel evolving domains into the Grid, namely multi-agent and semantics. By this, the Grid was enhanced to provide the requested capabilities from business end users. This chapter will show the rationale behind the performed developments and the way how BREIN addresses its four main objectives of enabling and/or enhancing: (i) Autonomy and Automation, (ii) Self-Optimization, (iii) Context-Aware Security, (iv) Reduced Complexity of Use with a dedicated focus on the major pillars of the framework, Virtual Organizations (VOs) and Service Level Agreements (SLAs). With that, a generic solution is presented, which can be applied to a variety of distinct application areas.

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INTRODUCTION

This chapter presents the results of the BREIN project (Business objective driven reliable and intelligent Grids for real business, IST-FP6-034556) which aimed at realising flexible, intelligent Virtual Organisation (VO) support, to significantly reduce the complexity of modern day business-to-business collaborations. The project was active from September 2006 to January 2010 with the plan to enhance classical Grid solutions by integrating Multi-agent and Semantic Web concepts to provide a dynamic, standard based environment for e-Business. The main focus was to move away from the Grid approach of handling individual resources, to a framework that allows providing and selling services, whilst those services usually represent a combination of different resource types.

The main objective of this chapter is to present, how an established technology like the Grid can be improved by integrating concepts and technologies originating from other research domains. By integrating multi-agent capabilities into the Grid, the control and adaptation of resources can be enhanced, to guarantee stable, managed execution across service providers. Additionally the integration of Semantic Web concepts provides the basis for increased interoperability and provides intuitive interfaces for policies and reasoning.

To provide best access for the reader, the chapter is structured as follows. First of all, the background of the work in BREIN is presented covering general issues, which led to the BREIN approach, as well as an examination of base concepts and technologies of the project. This created the basis for the four main BREIN objectives of enabling and/or enhancing: (i) autonomy and automation, (ii) self-optimization, (iii) context-aware security, and (iv) reduced complexity of use.

Furthermore the two validation scenarios of BREIN are described to give the reader further insight into the aims of the project before the concrete results and their innovations of the proj-

ect are presented. These scenarios represent two completely distinct application areas, the High-Performance Computing (HPC) domain and the Airport Logistics sector. Finally, a conclusion is drawn on what has been achieved but also on what needs to be done in future to further strengthen the uptake of Grids in e-Business.

BACKGROUND

From a historic viewpoint, the Grid paradigm was introduced within the academic domain as a concept for shared resources in a collaborative manner. Thereby the assumption was taken, that involved entities have the will to share these resources most likely for free (Foster, 2002). With that, the concept of Virtual Organizations (VOs) was born (Foster, 2001), representing a concept to describe and manage organizational shared resources for the purpose of achieving a common goal.

However, with the growing pervasion of all areas of life with information technology, the traditional ways of performing business also changed with a dedicated focus on the electronic area. Therefore new technologies such as Service-Oriented Architecture (SOA) or Cloud Computing were becoming of highest interest for industry. Especially the collaboration with other business players to extend the own portfolio of services is an important factor with respect to competitiveness in the market, which is in particular also a success criteria for Small and Medium Enterprises (SMEs).

The BREIN project was designed at a time, when the Grid evolved towards an industrial use, but existing solutions still showed a lack of capabilities, and, at the same time, were quite too complex to allow a simple deployment of services. Therefore the approach of BREIN started from the base premise to take into account the capabilities and needs of business end users in all developments and to provide a solution, which is easy to use and maintain.

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