Guest-editorial

Special Issue on "Smart Grid Technologies & Market Models"

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Grid Computing is a novel and active research domain, investigating architectures, methods, and protocols for complex, dynamic, distributed, and flexible resource sharing. Recent research on Grids has largely focused on issues of performance, scalability, and standardization. Yet, little has been done on aspects of intelligence and adaptability. To this end, agent and multi-agent technologies provide a promising approach to make Grid applications and solutions smarter, more flexible, and adaptable.

In more detail, two kinds of questions arise in this research area. On the one hand, technical questions concerning the Grid have to be solved, including advanced Grid architectures, semantically enhanced service descriptions, and the specification of resources. On the other hand, issues related to autonomy, collaboration, and economic models need to be treated. Key research topics here are market-based allocation and scheduling of resources, pricing, payment, automated negotiation, market mechanisms, self-organization and learning, engineering of Grid marketplaces and many others.

This special issue of the Multiagent and Grid Systems journal is dedicated to the topic of Smart Grid Technologies & Market Models. A workshop, named identically, has recently been carried out at the 5th International Conference on Autonomous Agents and Multi-Agent Systems in Utrecht, July 2005 and the contributions in this special issue are extended and revised versions of a number of the best papers from this event.

Specifically, this special issue comprises six contributions. Topics cover virtual organizations for the Grid based on agent technology go over market mechanisms for combinatorial resource scheduling, and architectures for decentralized economic models in Grids.

The first contribution by J. Patel et al. deals with virtual organizations (VO) for the Grid. The main contribution of this article is the introduction of highly scalable agent-based virtual organizations for Grid applications. Having introduced agent-based VOs, the authors show how to deal with uncertain information and monitoring the status of quality-of-service measures in virtual organizations on the Grid.

In the second contribution, Peter Gradwell et al. develop an alternative method for distributed multi-item resource allocation. Since combinatorial auctions have an inherent high complexity, the authors define multiple distributed single item auctions (MDAs) as a novel approach. They then use a simulation setup in order to evaluate the complexity and bidding behaviour of the participants and present an evaluation of their results.

Contribution number three, by Albayrak and co-authors, comprises advanced grid management software for seamless services. The authors introduce the notion of Advanced Grid Management Software for multi-modal access, security, and accounting and advanced messaging for managing Grid applications. AGMS shall provide Grid operators with an additional management and access level on top of existing grid management software tools.

The fourth contribution, by Michael Reinicke and co-authors, provides an evaluation of service selection techniques in service oriented computing networks. They compare several approaches of service selection methods in order to find out how to determine potential candidate instances in service oriented architectures. A particular focus lies in the design of a decentralized service selection approach and its comparison with a centralized baseline algorithm.

In the fifth article Oscar Ardaiz et al. develop an architectural framework for the incorporation of decentralized economic models in application layer networks and Grids. The main issue on which they focus is the composition of a middleware that is able to handle decentralized structures in allocating Grid resources from a technical perspective.

The final article, by Torsten Eymann et al., provides an introduction to Catallaxy-based Grid markets. The notion Catallaxy – stemming from F.A. v. Hayek – refers to bilateral bargaining and thereby the establishment of a spontaneous order in market scenarios. The main contribution of the paper is the design of a decentralized Catallaxy-based Grid resource allocation mechanism. The importance of the consideration of decentralized mechanisms stems from the fact that in scenarios with large numbers of traders, centralized mechanisms suffer a bottleneck syndrome while decentralized approaches are mostly restricted to local optima.

In summary, this special issue comprises a variety of articles that treat different aspects of the problem of allocating resources in highly distributed and volatile Grid markets. The technical issues presented are discussed in strong relation with the economic issues, which makes this interdisciplinary field especially attractive.

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