CAPM Indexed Hybrid E-Negotiation for Resource Allocation in Grid Computing

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ABSTRACT

Computational Grids are a promising platform for executing large-scale resource intensive applications. This paper identifies challenges in managing resources in a Grid computing environment and proposes computational economy as a metaphor for effective management of resources and application scheduling. It identifies distributed resource management challenges and requirements of economy-based Grid systems, and proposes an economy based negotiation system protocol for cooperative and competitive trading of resources. Dynamic pricing for services and good level of Pareto optimality make auctions more attractive for resource allocation over other economic models. In a complex Grid environment, the communication demand can become a bottleneck; that is, a number of messages need to be exchanged for matching suitable service providers and consumers. The Fuzzy Trust integrated hybrid Capital Asset Pricing Model (CAPM) shows the higher user centric satisfaction and provides the equilibrium relationship between the expected return and risk on investments. This paper also presents an analysis on the communication requirements and the necessity of the CAPMAuction in Grid environment.

Keywords: ANN Negotiator, Capital Asset Pricing Model (CAPM), CAPM Auction, Fuzzy Negotiator, Site Reputation

INTRODUCTION

Grid Computing (Foster, Kesselman, & Tuecke, 2001) is an emerging technology that focuses on uniformly aggregating and sharing geographically distributed heterogeneous collection of autonomous systems or resources which are interconnected by low latency and high bandwidth networks for solving large-scale applications (Foster, Kesselman, & Tuecke, 1999). In a large-scale grid, distributed resources belong to different administrative domains. Data Grids provide infrastructure for which accessing, transferring and managing large datasets stored in distributed repositories (Chervenak et al., 2009; Hoschek et al., 2000) that leads to a more decentralized approach to address the problem of computing power. Research driven by this has promoted the exploration of a new
architecture known as “The Grid” for high performance distributed application system. The term “Grid” is driven from an analogy to the electrical power supply in the sense that it has pervasive access to the power and can draw any resources from the distributed resource pool. Thus, a household draws electricity from power sockets irrespective of their physical location and the location of access points (Foster & Kesselman, 1999; Globus, 1999).

XML-based technologies are involving in interoperability issues, whereas we find some concepts by which we can provide common specifications on Grid architecture. This paper analyzes various methods and proposes an alternative modus operandi using fuzzy logic in auction based resource allocation Grid architecture. The method of handling imprecision must be excellent for an expert system to measure the natural probabilistic perception accurately. A key motivation of this paper is to aggregate the available fuzzy technologies and classical expert systems which can emulate the reasoning process on a static trusted Grid environment. The area of concentration is, to ensure the user centric service satisfactions by implementing fuzziness in negotiation and to classify service providers with better confidence by their reputation indexes for resource allocation.

The contribution of this paper are multifolds. Firstly, a protocol that introduces a virtual entity which continuously appraises site reputation using ascertained computational financial theories and feed it back to the user, which helps the users to classify the providers with higher confidence. This modified design is easily adaptable in established Grid architecture. Secondly, based on fuzzy theory and artificial intelligence a hybrid negotiation model is proposed. This hybrid e-negotiation model uses similar mechanism used in Continuous Double auction (CDA) for resource allocation (job scheduling) in Grid where the negotiation time is concise in considering the calculated index by the virtual entity. The second section describes the key processes in economy driven Grid architecture and the necessity of the proposed virtual entity. Human perceptions and judgment through Analytic Hierarchy Process (AHP) in determining the relative merit of a set of alternative is discussed in the third section. AHP validates the CAPMAuction model and helps to estimate the reputation indexing among Grid sites according to the user assessments. The fourth section proposes highly scalable resource allocation protocol which helps us to integrate auction terminology which overlay the Grid architecture to a commodity super market. Modern economical theories and artificial intelligence helps to develop a hybrid negotiation model which is explained here where the negotiation model evaluates the proposals and counter-proposals more humanly. The fifth section explains the empirical study to test the validity of our proposed protocol and the negotiation model followed by conclusion.

RELATED WORK

This paper deals with scheduling and allocating independent parallel jobs in a heterogeneous Grid architecture continues to evolve as the overall design concepts continue to improve and as it is employed for additional tasks. A computational economy framework is a modified Grid environment which is built on the existing Grid middleware systems and offered an infrastructure for resource management and traded in the Grid environment. Economy based models of grid resource allocation and management, just as a commodity market, share resources are based on negotiating about the usage duration or time, the usage fee, QoS (Quality of Services) and some other items between the owner or his broker and consumer of grid resources.

A market-based approach in computational system design has been the topic of research over the years (Stonebraker et al., 1994; Smith and Davis, 1980; Cocchi et al., 1993; Lazar & Semret, 1997). Some of these systems have developed a substantial theoretical foundation but without large-scale deployment, experimental validation, and testing. A number of recent systems are attempting to apply computational economy for Web based computing.
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