Service and Utility Oriented Distributed Computing Systems: Challenges and Opportunities for Modeling and Simulation Communities

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Grids and peer-to-peer (P2P) networks have emerged as popular platforms for the next generation parallel and distributed computing. In these environments, resources are geographically distributed, managed and owned by various organizations with different policies, and interconnected by wide-area networks or the Internet. This introduces a number of resource management and application scheduling challenges in the domain of security, resource and policy heterogeneity, fault tolerance, and dynamic resource conditions. In these dynamic distributed computing environments, it is hard and challenging to carry out resource management design studies in a repeatable and controlled manner as resources and users are autonomous and distributed across multiple organizations with their own policies. Therefore, simulations have emerged as the most feasible technique for analyzing policies for resource allocation.

This paper presents emerging trends in distributed computing and their promises for revolutionizing the computing field, and identifies distinct characteristics and challenges in building them. We motivate opportunities for modeling and simulation communities and present our discrete-event grid simulation toolkit, called GridSim, used by researchers world-wide for investigating the design of utility-oriented computing systems such as Data Centers and Grids. We present various case studies on the use of GridSim in modeling and simulation of Business Grids, parallel applications scheduling, workflow scheduling, and service pricing and revenue management.