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GridSim: A Toolkit for the Modeling and Simulation of Global Grids

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ABSTRACT

Clusters, Grids, and Peer-to-Peer (P2P) networks have emerged as popular paradigms for next generation parallel and distributed computing. They enable aggregation of distributed resources for solving large-scale problems in science, engineering, and commerce. In Grid and P2P computing environments, the resources are usually geographically distributed in multiple administrative domains, managed and owned by different 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, continuously changing resource conditions, and politics. The resource management and scheduling systems for Grid computing need to manage resources and application execution depending on either resource consumers' or owners' requirements, and continuously adapting to changes in resource availability.

The management resources and scheduling of applications in such a large-scale distributed systems is complex undertaking. In order to prove the effectiveness of resource brokers and associated scheduling algorithms, their performance need to evaluated under different scenarios such as varying number of resources and users with different requirements. In Grid environment, it is hard and even impossible to perform scheduler performance evaluation in a repeatable and controllable manner as resources and users are distributed across multiple organizations with their own policies. To overcome this limitation, we have proposed and developed a Java-based discrete-event Grid simulation toolkit called GridSim. The toolkit supports modeling and simulation of heterogeneous Grid resources (both time and space-shared), users and application models. It provides primitives for creation of application tasks, mapping of tasks to resources and their management. To demonstrate suitability of the GridSim toolkit, we have simulated a Nimrod-G like grid resource broker and evaluated the performance of deadline and budget constrained cost- and time-minimization scheduling algorithms.