Tutorial 3 — The Gridbus Toolkit for Grid and Utility Computing

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Abstract

Computational Grids enable the sharing, selection, and aggregation of geographically distributed resources (such as computers, databases, scientific instruments) for solving large-scale problems in science, engineering, and commerce. However, application development, resource management, scheduling, and supporting end-to-end quality-of-services (QoS) in these environments is a complex undertaking. This is due to the geographic distribution of resources that are owned by different organizations having different usage policies and cost models, and varying loads and availability patterns. To address these challenges, we have developed distributed computational economy framework for resource allocation and regulation of supply-and-demand for resources. We applied this framework in the design and development of scheduling systems that manage distributed resources in a single administrative domain (cluster computing) and also in multiple administrative domains (grid computing).

The Gridbus Project is engaged in the design and development of cluster and grid middleware technologies for service-oriented computing. They include visual Grid application development tools for rapid creation of distributed applications, competitive economy-based Grid scheduler, cooperative economy-based cluster scheduler, Web-services based Grid market directory (GMD), Grid accounting services, and a widely used GridSim toolkit. These tools have been used in Grid-enabling applications such as molecular docking and neuroscience and deploying them for distributed proceedings on Global Grids.

This tutorial covers four topics. First, we briefly review emerging trends in network-based high performance computing and identify application development and resource management challenges. Then, we introduce our framework on Grid Architecture for Computational Economies (GRACE) that leverages existing technologies such as Globus and provides new services that are essential for constructing industrial-strength Grids. We discuss Gridbus technologies and their use in Grid enabling application, the use of our economic grid infrastructure in scheduling parametric computations containing hundreds of jobs for execution on the World Wide Grid (WWG) testbed. Particular emphasis will be placed on Grid economy, how to design and develop Grid technologies and applications capable of dynamically leasing services of distributed resources at runtime depending on their availability, capability, performance, cost, and users’ quality of service requirements. Finally, we present the usage of tools in composition and distributed execution of data-intensive applications (e.g., molecular docking, brain activity analysis, and high-energy physics) on the Grid to demonstrate capabilities of Gridbus system.