Chapter 6.9
Grid Transaction Management and Highly Reliable Grid Platform

Feilong Tang
Shanghai Jiao Tong University, China

Minyi Guo
Shanghai Jiao Tong University, China

ABSTRACT

As Grid technology is expanding from scientific computing to business applications, open grid platform increasingly needs the support of transaction services. This chapter proposes a grid transaction service (GridTS) and GridTS based transaction processing model, defines two kinds of grid transactions: atomic grid transaction for short-lived reliable applications and long-lived transaction for business processes. The chapter also presents solutions to managing these two kinds of transactions to reach different consistent requirements. Moreover, this chapter investigates a mechanism for automatic generation of compensating transactions in the execution of long-lived transactions through the GridTS. Finally, it discusses the future trends along the reliable grid platform research.

INTRODUCTION

Grid computing is a natural evolution of distributed computing and Internet applications for large-scale science and engineering problems, aiming at effective resource sharing and task collaboration in distributed and self-governing environments. The main goal of grid computing is sharing large-scale resources and accomplishing collaborative tasks through enabling people to utilize computing and storage resources transparently. By providing service oriented computing and data infrastructures, grid technology is becoming the preferred basis for large-scale distributed computing, and expanding from scientific computing to business applications (Berman,2003; Foster,2002; Wang, 2004).

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Many key grid applications especially business applications require reliability guarantee from highly reliable grid computing platform (Jiang 2006). As an effective and widely-used means, transaction technology can help people to make this vision a reality, providing application developers with multiple transparencies on location, replica, concurrency and failure (Wang, 2008). As a result, transaction management is one of the most important core services of reliable grid platform for the mission-critical commercial grid applications (Yang, 2008).

In grids, a transaction is a set of operations that execute on geographically distributed grid services. Transaction management service is responsible for ensuring the reliable execution of these distributed grid applications to keep the system consistent, free the applications from various failures. Ideally, it also shields users from the complex recovery process.

The traditional distributed transactions, where application systems are tightly coupled, have the ACID properties, i.e., Atomicity, Consistency, Isolation and Durability. However, traditional distributed transaction models and Web service transaction specifications do not work in open grid environments because:

- Grid systems are loosely coupled and autonomous. For the security and efficiency, autonomous grid services typically do not allow to be locked by outside applications while traditional atomic transaction models generally adopts locking mechanism to guarantee the atomicity.
- It is difficult even impracticable for application programmers to develop compensating transactions. Existing transaction models require application programmers to provide all compensating transactions. However, grid services that execute a business application are dynamically discovered; and autonomous service providers may set up special compensating rules based on their own business models. For example, some service providers allow users to cancel a ticket order without other actions while others may require users to pay some compensating fee.
- Grid systems are dynamic, i.e., grid services may exit the systems dynamically during an execution of a business process. Grid transaction service has to hide the dynamism from users.

As a result, it is a very important and significant work to propose and implement a transaction service for grid computing. Generally, a grid transaction service has to address following issues:

- Coordination of the short-lived activities to form an atomic transaction, such as transferring fund from one bank account to another.
- Coordination of the long-lived transactional activities to fulfill a common agreement, for example, a journey arrangement that involves booking tickets, booking hotel rooms and hiring cars.

This chapter presents a grid transaction service (GridTS) and coordination algorithms to manage atomic and long-lived grid transactions, providing commercial applications with reliability support. Moreover, we propose a solution for automatic generation of compensating transaction, which is an significant advantage over existing long-lived transaction models. The objective is to set up a reliable grid platform based on transaction service for grid applications with reliable requirements, enabling application programmers to use the GridTS to implement transactional applications easily. The proposal has the following advantages over existing related researches. Firstly, the GridTS can automatically generate compensating transactions. Secondly, the GridTS can hide the dynamicity of grids from users. Next, the GridTS reserves resources for the atomic transaction com-