

Chapter 105

Policy Driven Negotiation to Improve the QoS in Data Grid

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INTRODUCTION

Data grids have become an interesting and popular domain in grid community (Foster and Kesselmann, 2004). Generally, the grids are proposed as solutions for large scale systems, where data replication is a well-known technique used to reduce access latency and bandwidth, and increase availability. In splitting of the advantages of replication, there are many problems that should be solved such as,

- The replica placement that determines the optimal locations of replicated data in order to reduce the storage cost and data access (Xu et al, 2002);
- The problem of determining which replica will be accessed to in terms of consistency when we need to execute a read or write operation (Ranganathan and Foster, 2001);
- The problem of degree of replication which consists in finding a minimal number of replicas without reducing the performance of user applications;
- The problem of replica consistency that concerns the consistency of a set of replicated data. This consistency provides a completely coherent view of all the replicas for a user (Gray et al 1996).

Our principal aim, in this article, is to integrate into consistency management service, an approach based on an economic model for resolving conflicts detected in the data grid.

The reminder of the article is organized as follows. The next section describes the fundamental principles of pessimistic and optimistic consistency approaches. Section 3, is devoted to the description of the model used in our consistency management service. In section 4, we describe our consistency

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management service and its algorithms for replicas in data grid. It is based on the economic model (Buyya and Vazhkudai, 2001). An evaluation and comparison of our proposition with other approaches are presented in Section 5. Section 6 briefly presents related pioneering works for resolution of the conflicts among the divergent replicas. Finally, Section 7 concludes this work by some future tracks.

APPROACHES TO CONSISTENCY MANAGEMENT

Data replica is made up of multiple copies, on separate computers. It is a significant technology which improves availability and execution. But the various replica of the same object should be coherent. There are many consistency models, which neither offer the same performances nor impose the same constraints to the application programmers.

The replica consistency management can be done either in a synchronous way by using what is known as pessimistic algorithms, or in an asynchronous way by employing what is designated as optimistic algorithms.

1. The Pessimistic Approach forbids any access to a replica provided that it is up-to-date (Saito and Shapiro, 2005). This allows guaranteeing a strong consistency, and so avoiding any problem linked to the stage of reconciliation. A basic protocol, called RAWA (Read Any Write All) (Zhou et al. 2004) consists in obtaining an exclusive lock on all the copies before affecting a writing (respectively reading) on one of the copies. The availability of the readings is improved with protocol ROWA (Read Once Write All) (Goel et al. 2005). The readings lock and access only one copy, while the write access mode continues to lock and modify

all the copies. Nevertheless, this protocol is blocked in the event of breakdowns. Another strategy of replication is proposed by the vote protocol family by Quorum (Rodrigues and Raynal, 2003). The transactions are sent to a group of copies which vote (to decide which update is the most recent: writing or reading). Here, we can raise three major weaknesses of this type of approach:

- It is very badly adapted to vague or unstable environments, such as mobile systems or grids at strong rate of change;
- It cannot support the update cost when the degree of replication is very high;
- It is unsuitable for environments which require data sharing such as collaborative environments.

2. The Optimistic Approach: This approach authorizes access at any time to any replica. In this way, it is then possible to access a replica which is not necessarily coherent (Saito and Shapiro, 2005). So, this approach tolerates a certain difference between replicas. Although it does not guarantee strong consistency as in pessimistic case, it enjoys, nevertheless, certain number of advantages which we can summarize as follows:

- They improve availability: This is because the access to data is never blocked;
- They are flexible as regards the network management which does not need to be completely connected so that the replicas are completely accessible;
- They can support a large number of replicas since they do not require high synchronization among replicas;
- Its algorithms are well-adapted to large scale systems.

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