Virtualization in grid environments is a recent way to improve platform usage. ViSaGe\(^1\) is a middleware designed to provide set of functionalities needed for storage virtualization: transparent reliable remote access to data and distributed data management. ViSaGe aggregates distributed physical storage resources. However, ensuring the performances of data access in grid environment is a major issue, as large amount of data are stored and constantly accessed, and directly involved into tasks execution time. Especially, the placement and selection of replicated data are made particularly difficult because of the dynamic nature of grid environments – grid nodes workload variations. The workload variations represent the state of the system resources (CPU, disks and networks). These variations are mainly perceived by a monitoring system. Several monitoring systems exist in the literature. They monitor system resources consumption and applications but none of these systems presents the whole of the pertinent characteristics for ViSaGe. ViSaGe needs a system that analyzes nodes workload during runtime execution for improving data storage management. Therefore, ViSaGe Administration and monitoring service, namely Admon, is proposed. In this chapter, we present Admon and its workload prediction model. Admon allows to dynamically placing data according to resources usage, especially disk I/O workload, ensuring the best performances while limiting the monitoring overhead. Experiments show the relevance of Admon decisions.

12.1 Introduction

The grid concept [1] defines the aggregation of heterogeneous computing and storage nodes. It offers a wide range of distributed physical resources to data storage activity, es-

\(^1\)ViSaGe is the French acronym of: Virtualisation du Stockage applique aux Grilles informatique – storage virtualization applied to computing grids. It is a French national project funded by the RNTL research program under contract # 04k459 and supported by the French Ministry of Education and Research. The industrial project partners are: EADS CCR, CS SI and Seanodes.
especially for scientific applications, such as biology research and simulation for climate. These applications generate access to large amount of data and use deployed grid storage resources to store data. Thus, remote data access must be handled by a dedicated grid storage system in order to manage the distribution of data (the storage usage) and to ensure performance. The main goal of storage systems is to gather physical distributed data resources into one virtual storage resource. Therefore, they act like grid middleware in handling the heterogeneity and the dynamic nature of nodes and network, while providing one transparent and uniform data access interface to the users, making data access as easy on the distributed environment, as on one single machine.

ViSaGe, presented in [2, 3] provides to grid users a transparent and reliable storage virtualization system using data management protocols. This service respects grid hierarchical architecture. This architecture is composed of three levels: the grid level (represents the grid gate), the site level (the frontal site) and the node level (represents the storage nodes and computing nodes). ViSaGe is funded mainly on three principal components. These components are the virtualization service: $Vrt$, the grid file system: $Visagefs$ [4], and the administration and monitoring service: $Admon$. ViSaGe federates heterogeneous and geographically dispersed physical storage resources into virtual spaces featuring various qualities of services (QoS). Each virtual space consists of logical volumes. The logical volumes, in their turn, consist of data storage units. A data storage unit represents the physical placement of the data on the grid nodes. To each data storage unit is associated a data placement policy. However, the data storage units are integrated in distributed nodes across a wide area network. These nodes are characterized by varying capacity and availability. In distributed storage systems such as ViSaGe, policies are enforced with storage management protocols, such as data replication. Data replication allows both the optimization of network bandwidth [5], and data access reliability [6]. Therefore, the workload variations of several components in the end-to-end path linking source and sink [7], are not the only parameters that must be taken into consideration to improve replication performance. As a matter of fact, data replication implies more read/write operations of disk devices. However, the challenge here is that the disk devices in grid environment are characterized by high heterogeneity and workload variations, with direct impact on the applications throughput.

This chapter focuses on the using of the Admon functionalities for covering and improving management of the I/O workload into ViSaGe. The remainder of this chapter is composed as follows: Section 12.2 presents related work motivating the need of a system like Admon. Section 12.3 illustrates the grid environment followed by the ViSaGe environment