Chapter 1
Desktop Grids and Volunteer Computing Systems

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ABSTRACT

Desktop Grids and Volunteer Computing Systems (DGVCSs) are approaches of distributed systems aimed at the provision of large scale computing infrastructures to support eScience project, by taking advantage of non-dedicated resources, most of them desktop computers presenting low levels of use. Those computers are available through Internet or Intranet environments, have partial availability, are highly heterogeneous, and are part of independent administrative domains. Currently, the idle computational capabilities of millions of volunteer distributed computing resources are exploited without affecting the quality of service perceived by the end users. This chapter presents a comprehensive state of the art of DGVCSs, providing a global picture of the main solutions and research trends in DGVCSs. It will discuss the evolution of such systems by analyzing representative examples. We identify the main characteristics for DGVCSs, and we introduce a new taxonomy to categorize these projects to make their study easier.

INTRODUCTION

Also known as volunteer computing (Sarmentwa, 2001) or public resources (Anderson, Cobb, Korpela, Lebofsky, & Werthimer, 2002) (SETI@home, 2010), Desktop Grids and Volunteer Computing Systems (DGVCSs) are approximations of the distributed computing which seek to maximize the efficient use of partially available computing resources. This includes the non exclusive use of computing resources, while ensuring that interactive users of those shared resources do not perceive any deterioration in the quality of service. Such strategies are intended to provide a computing infrastructure at a large scale, primarily used to support the development of e-science projects,

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without incurring into additional investments for the purchase and maintenance of hardware, physical space and controlled temperature environments of the traditional vertical growth dedicated infrastructures.

DGVCSs focus on the search for an efficient solution to the demand for computing capabilities to large scale, whose provision would be economically unviable through a centralized approach. This solution has focused on leveraging computing infrastructures, characterized by remaining underutilized and whose capital and operational costs are borne by the users or donor organizations. These features have allowed the deployment of Internet scalable computing infrastructure, composed mainly by economic, heterogeneous, distributed and partially available computers whose added processing power has become in the order of the PetaFLOPS (Floating point Operations per Second) (Anderson & Fedak, 2006).

Taking into account the relevance of DGVCSs, this chapter presents a representative set of projects focused on providing solutions for the use of idle computing cycles. This chapter aims to provide an overview of the main implementations and research on DGVCSs. This discusses their evolution through the analysis of representative projects and proposes a new taxonomy to facilitate their study by identifying the main features available and desirable for DGVCSs. Then, we highlight new issues that should be addressed in future research and finally, we present the conclusions of the chapter.

DGVCSS STATE OF ART

This section provides a description of the most relevant DGVCSs projects, chronologically arranged and categorized by their contribution. We start with the first documented research project on DGVCSs and end with projects still under development.

DGVCSs over LANs

This category represents the origin of DGCVSs and is characterized by the use of pre-existing computational resources with low distribution and heterogeneity, connected by a Local Area Network (LAN). These conditions made experimenting with different strategies to use non dedicated resources easy, particularly by taking advantage of idle computational cycles. Within this category, we highlight two precursor projects: Worm (Shoch & Hupp, 1982) and Condor (Litzkow, Livny, & Mutka, 1988).

Worm Project

The Worm project is considered to be the first-distributed computing project able to use idle computing processing cycles. This project was proposed in 1978 by Xerox Palo Alto Research Center (PARC) and was intended to develop Worm applications, able to span machine boundaries and also replicate themselves in idle machines, moving processes between multiple machines connected over a LAN. Worm included mechanisms for the detection of idle machines and for process replication.

The main contribution of the Worm Project was laying the foundation for the use of not dedicated computing resources by the programming of opportunistic executions during night hours, when most computational resources arranged in Xerox Palo Alto could be considered idle. The test suite was made using an infrastructure with homogeneous characteristics, which included 100 Alto computers, each connected by an Ethernet LAN to file servers, boot servers and name resolution servers. The computational infrastructure used in the experiment is shown in Figure 1 (Adapted from Shoch and Hupp (1982)).

Because of the existence of accessible storage devices through the LAN, as well as dedicated storage servers, the design of the Worm programs originally discarded the possibility of using the

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