Chapter 1.4
Taxonomy of Grid Systems

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ABSTRACT

Advances in Grid computing are stimulating the emergence of novel types of Grids. Accessible Grids, manageable Grids, interactive Grids and personal Grids represent a significant evolution of Grid computing. More and more researchers are realising the potentials of emerging Grids in bridging the current gap between Grid technologies and end users. Nevertheless, no reviews or classifications on emerging Grids are available. Therefore, this chapter aims to give a review on Grid systems. It sets out to develop a comprehensive classification of both traditional and emerging Grid systems with an aim to motivate further research and to assist in establishing a solid foundation in such a rapidly developing and expanding field.

1. INTRODUCTION

During the last few years, information technology has witnessed a rapid advancement in every aspect, including speed, performance and cost. This substantial advancement has affected not only the application areas in which grid technologies can be applied, but also the underlying architecture of how grids are developed, deployed and run. Accessible Grids, Manageable Grids, Interactive Grids and Person-Centric Grids represent a significant evolution of grid systems with an ambitious vision of providing grid services in the form of a Service Oriented Knowledge Utility (SOKU) (NGG group, 2006). At the same time, new distributed system paradigms, such as utility computing, everything as a service and cloud computing, have surfaced with the same vision as grid computing. This has raised the question of whether they really propose new solutions replacing grid systems or they are merely new commercial names for grid computing.

This chapter presents a comprehensive taxonomy of grid systems with an aim to establishing a solid foundation in such a rapidly developing

DOI: 10.4018/978-1-4666-0879-5.ch1.4

field. Such a comprehensive taxonomy has not been reported in the literature and is important for the following reasons: first, it facilitates a study of grid systems under one framework and eases an understanding of their similarities and differences. Second, it allows one to see main design features of grid systems clearly and assists a detailed inter-comparison of different grid systems. Third, it helps in understanding current research trends in grid computing and anticipating future trends.

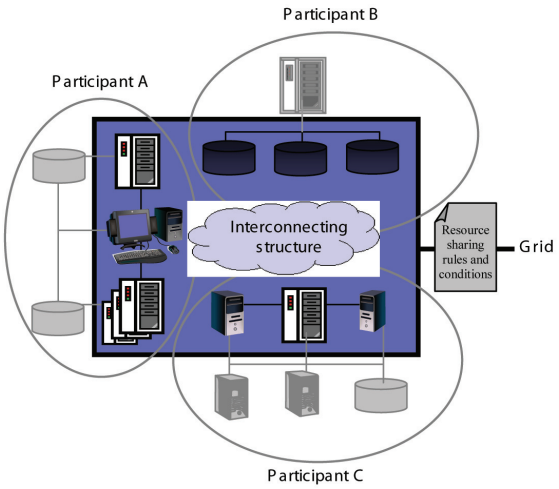
2. BACKGROUND

2.1. Grid Computing

Basically, grid computing (Foster & Kesselman, 2003) is a relatively new distributed system paradigm where computational resources are coupled together to form a large-scale distributed system where all resources are available for sharing. This has the great advantage of providing a resource-rich infrastructure capable of solving data intensive and complex computational problems such as protein folding and weather forecasting in an acceptable time and at a reasonable cost.

Indeed, there are as many definitions to the grid as the growing number of organizations utilizing it. A common theme underlying these definitions is the coordinated resource sharing and problem solving in a virtual organisation (VO). A VO is a dynamic set of participants defined around a set of resource sharing rules and conditions as shown in Figure 1. Some grid definitions add additional criteria requiring the grid resources to be distributed across multiple administrative domains (Foster, 2001) (Joseph & Fellenstein, 2003) or to be geographically distributed (Buyya, 2005). These additional criteria exclude clusters, where shared resources are usually in the same locality and administrative domain, from the grid definition. However, some leading grid authorities, such as Sun Microsystems (Sun Microsystems, 2009), do consider clusters as grid environments,

Figure 1. Grid environment



they use the term 'Cluster Grids' to refer to them (Sun Cluster Grid, 2002).

2.2 Grid Generations

Grid computing is a rapidly evolving area of research characterised by a number of distinct phases or generations, as shown in Figure 2. The grid started in the early nineties, as a model of meta-computing where resources in supercomputers were shared; subsequently the ability to share data was added. This is usually referred to as first generation grids. By the late nineties (1998), the framework for second generation grids, which are characterised by their focus on the use of grid middleware systems to glue different grid technologies, was published (Foster & Kesselman, 1999). In the early millennium (2001) fast data transfer and storage request brokers for persistent data storage with metadata description were added to grid platforms introducing what are usually known as 2.5 grid generation. Late in 2002, third generation grids originated by combining the Web technology with the second generation grids (Jeffery, 2007).

Recently, the Next Generation Grids (NGG) (NGG group, 2003; NGG group, 2004; NGG