Chapter 8.11
A Complementary Approach to Grid and Cloud Distributed Computing Paradigms

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ABSTRACT

Cloud computing is a new kind of computing model and technology introduced by industry leaders in recent years. Nowadays, it is the center of attention because of various excellent promises. However, it brings some challenges and arguments among computing leaders about the future of computing models and infrastructure. For example, whether it is going to be in place of other technologies in computing like grid or not, is an interesting question. In this chapter, we address this issue by considering the original grid architecture. We show how cloud can be put in the grid architecture to complement it. As a result, we face some shadow challenges to be addressed.

INTRODUCTION

In 1998 and later in 2001, Foster, Kesselman, & Tuecke (2001) introduced Grid Computing as coordinated resource sharing and problem solving in dynamic, multi-institutional Virtual Organization (VO). Grids have been the center of attention from Science and High Performance Computing (HPC) (Grandinetti, 2008; Gentzsch, Grandinetti & Joubert, 2010) community especially for the distributed and large scale scientific applications and also in collaborative works. A huge number of projects within countries (e.g. National Grid Projects) (TeraGrid, 2010; Italian Grid Infrastruc-

DOI: 10.4018/978-1-4666-0879-5.ch8.11

ture, 2010), continents and companies in various areas were defined around grid during these years. To make grid computing a promising technology, a number of groups and standard bodies such as Open Grid Forum in the industry and science initiated to standardize various components of distributed systems like interfaces and architecture.

For instance, in the Europe, the European Grid Initiative (EGI) (EGI, 2010) is the latest project that represents a new effort to establish a sustainable grid infrastructure in Europe after EGEE-III project. National Grid Initiatives (NGI) (Italian Grid Infrastructure, 2010) within EGI operate the grid infrastructures in each country. In fact, NGI is the main foundations of EGI. In the meantime, a new computing paradigm emerges from commercial sector with focus on Enterprise applications called Cloud Computing (Amazon EC2., 2009). As a matter of fact, some new technologies like virtualization for provisioning of operating system and Web Services were the main foundations behind cloud Computing.

In other words, cloud computing is the next generation IT computing paradigm in which dynamically scalable and often virtualized resources are provided as a service over the Internet. The main concept in cloud is an infrastructure that provides on-demand, instant and also elastic resources or services over the Internet, usually at the scale and reliability of a data center. Cloud platform such as Open Source Nimbus Toolkit (Nimbus, 2010) is one of the first attempts to complement grid and cloud. Nimbus is like Commercial Amazon Elastic Compute Cloud (EC2) (Amazon EC2., 2009) that provides computational capabilities for computing in Enterprise sector; they are often referred as Infrastructure-as-a-Service (IaaS). After the advent of cloud in commercial settings, some interesting new research questions arise like: "Does grid and cloud complement each other?". In addition, the question: "Can IaaS clouds be a good provisioning model for a grid Infrastructure?" is very worthy to be discussed. Again, whether IaaS clouds can provide enough performance and speed in computation, storage and networking for HPC applications or not, is also an important issue to be examined.

In this chapter, we introduce the new buzzword computing paradigm cloud especially from the infrastructure point of view. After introducing this paradigm, we discuss analytically about various technologies around it in software and networking domains that are involved in complementing grid and cloud. Next, the needs of science to cloud are described, followed by benefits of cloud computing. In next part, the main contribution of this chapter that is grid meets cloud is presented. Then, we analyze and assess current practices and services of cloud in grid. Finally, we define some new research topics that can address this issue.

BACKGROUND

The precise definition of cloud computing varies widely and depends on the context because clouds are not mature enough and they are in the evolution stages. First, we have some explanation about the term cloud. Since the birth of TCP/IP, people have been drawing TCP/IP Network on white boards like cloud metaphor. This metaphor resonates for the same reason the "electron cloud" is a useful metaphor for the behavior of electrons. The cloud represents a black-box, we don't have to know its inner workings, just its behaviors or interfaces are needed by users.

On the other hand, cloud computing is the ability to draw IT resources from an internal, external or third-party source using either Internet-based or local-area infrastructure. The cloud is essentially the Software-as-a-Service (SaaS) model expanded to include hardware-driven functions like storage and processing.

In Information Technology, Software, Platform and Infrastructure are the three main elements that services come from them. Software runs on a Platform and Platform runs on an Infrastructure. Currently, the clouds are trying to cover the three