Chapter 14

Energy Management in Cloud Computing

Ganesh Neelakanta Iyer
Progress Software Development, India

Pattabhi Mary Jyosthna
B.V. Raju Institute of Technology, India

Suman Jonnalagadda
B.V. Raju Institute of Technology, India

ABSTRACT

Due to the growing demand of businesses, enterprises are concentrating on performance improvement as well as investment reduction for their applications. Cloud Computing, an emerging technology which provides enormous services through internet is the best choice for the enterprises to improve their business performance and to reduce their capital budget. Cloud datacenters have thousands of servers to provide uninterrupted services to the consumers. These High Performance Computing systems consumes high energy, which leads to increase in Cloud Service Providers operational cost. Apart from the operational cost it also increases CO2 emission, which causes Global warming. So many researchers are evolving engineering techniques that are required to improve performance as well as optimization in power consumption. This chapter describes some of the techniques that are used to reduce operational cost, CO2 emission, SLA violation and able to maintain Quality of Service (QoS). It also describes about limitations on existing methods and further enhancement issues for better performance.

INTRODUCTION

Cloud Computing is an on-demand Internet service which provides everything as a service (XaaS) on pay-as-you-go basis. Some of the services provided by cloud computing are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Organizations are utilizing these services to improve their computing performance and also to reduce their maintenance investment. Consumers can communicate with Cloud Service Providers (CSPs) through internet to access these services without any human interaction. CSP provides shared pool of resources to...
multiple consumers using a multi-tenant model with respect to consumer demand. Consumer can also extend his limit of resource utilization capability based on his requirement. Small, medium and large-size organizations are moving towards the cloud technology to reduce their maintenance cost - includes the required number of computing systems, storage and software - to run their applications. These organizations are also thinking about the energy consumption, because high energy consumption of computing systems can limit further performance growth and carbon dioxide footprints. Hence, the goal of the computing systems has been shifted from performance improvements to power and energy efficiency. Organizations can improve performance and reduce CO2 emission by adopting cloud technology. A recent research by Accenture shows that moving business applications to cloud can reduce carbon footprint of organizations. According to the report, if enterprises adopt cloud technology, small businesses can observe up to 90% reduction in carbon emission. Large and medium-size organizations can save at least 30-60 and 60-90 percent. So organizations are showing interest to adopt cloud technology because of its services and essential characteristics.

**Cloud Services**

**Infrastructure as a Service (IaaS)**

According to IETF (Internet Engineering Task Force), IaaS providers offer Physical or virtual machines, storage, networking, firewalls and data-center space to the organizations. It is best option for the small-scale organizations who cannot invest more on hardware equipment and maintaining own data centers. Clients can pay to the provider based on the amount of resources consumed by them. Some examples of IaaS providers include AWS and Rack space.

**Platform as a Service (PaaS)**

With PaaS cloud providers can provide the complete environment required to building and developing web based applications. This includes operating system, database, and web server. PaaS is useful when multiple members involve in developing a project or when the people want to interact with the development process and when developers wish to automate testing and deployment services. Some of the example PaaS providers are Google App Engine, Microsoft Azure Services.

**Software as a Service (SaaS)**

Software as a Service is a software delivery method which provides the consumers or the organizations to access the software and its functions remotely as a Web-based service at a cost typically less then paying for licensed applications. Moreover it removes the need for organizations to handle the installation, set-up, daily upkeep and maintenance. Google Apps and Facebook games some commonly used SaaS applications (figure 1).

**Cloud Computing Deployment Models**

Cloud computing has four deployment models: Public Cloud, Private Cloud, Hybrid Cloud and Community Cloud. Business can chose any of them to deploy their applications.

**Public Cloud**

The Cloud Services which are rendered over a network that is open for public use is called as “Public Cloud”. Public cloud services may be free or offered on a pay-per-usage model. Generally, public cloud providers like Amazon AWS, Microsoft and Google own and operate the infrastructure and offer access over the Internet.
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