Chapter 49
Energy-Efficient Task Consolidation for Cloud Data Center

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ABSTRACT

Energy saving in a Cloud Computing environment is a multidimensional challenge, which can directly decrease the in-use costs and carbon dioxide emission, while raising the system consistency. The process of maximizing the cloud computing resource utilization which brings many benefits such as better use of resources, rationalization of maintenance, IT service customization, QoS and reliable services, etc., is known as task consolidation. This article suggests the energy saving with task consolidation, by minimizing the number of unused resources in a cloud computing environment. In this article, various task consolidation algorithms such as MinIncreaseinEnergy, MaxUtilECTC, NoIdleMachineECTC, and NoIdleMachineMaxUtil are presented aims to optimize energy consumption of cloud data center. The outcomes have shown that the suggested algorithms surpass the existing ECTC and FCFSMaxUtil, MaxMaxUtil algorithms in terms of the CPU utilization and energy consumption.

1. INTRODUCTION

Cloud is a provision of delivering the on-demand computing resources such as storing, managing and processing data over the internet. It meets the demand of the users by providing the information and communication relating to technology infrastructure. One can obtain these resources from various cloud computing providers. The data centers make these computing services available to users. Cloud computing environments cater in to the growing computational demand and huge volume of data through the devices of high speed storage and high-performance servers (Beloglazov et al., 2012; Patra & Barik., 2014). As discussed by Hwang et al. (2012) and Mell et al. (2011) cloud computing infrastructures are thus been created such that it is able to provide support to various utility oriented IT applications by the

DOI: 10.4018/978-1-7998-5339-8.ch049

users. The development of technologies like network devices, hardware capacities and software applications has made cloud computing a popular computing paradigm (Ouf et al., 2015; Goswami et al., 2012).

In all these computing systems the resources can be dispersed widely and the resources that are taking part in the system building are the numerous physical servers building the data centers. Proficient methods of management are required to join them together and make the resources to use them optimally at various scales. Therefore, in recent years the focus of research has shifted to exploit resources efficiently for minimizing the power consumption by data centers. Cloud applications consume huge volumes of energy and hence be considered as the major sources of the power consumption along with other physical infrastructures such as cooling and air-conditioning (Rodero et al., 2010; Buyya et al., 2009). Therefore, there is a need to develop and use efficient technology to reduce energy consumption by designing state of the art green data centres (Liu et al., 2009). The objective thus is to save energy and it can be achieved through task consolidation and server consolidation through virtual machines by sharing the same VM.

Now days, computational capacities and facilities have been continuously improved in order to meet the number of customer requests (Stergiou et al., 2016). In order to gain competitive edge, the proportional non-negligible amount of the required energy has been often left behind. Recent advocacy and tightly coupled with energy consumption called green or sustainable computing has been paid serious attention in the field of computation as there is a large need of minimizing the energy consumption. The scope of sustainable computing has become broad and has been expanding into a much larger range of resources associated with auxiliary equipment, such as the water used for cooling and the physical/floor space occupied by the resources (Angli., 2013; Jouini et al., 2016).

In Cloud computing, energy consumption and resource utilization are strongly associated. In particular, resources with a low utilization rate still consume considerable amount of energy as compared to energy consumed by fully utilized Cloud computing (Srikantaiah et al., 2008). Recent studies (Lefurgy et al., 2008; Fan et al., 2007) revels that on an average, resource utilization in most data centers is as low as 20%, and energy consumption of idle resources is as high as 60% (Barroso et al., 2007). Task consolidation is considered to be an efficient technique to increase the utilization of resources. It is enabled by virtualization technologies which facilitate the execution of several tasks concurrently and thus reduce energy consumption (Bohrer et al., 2002; Gupta et al., 2017).

2. ENERGY EFFICIENCY IN CLOUD COMPUTING

In the last years cloud computing has become more and more popular. This increase in popularity of cloud services results in higher resource demands on the providers end. More resources mean more energy consumption and thus higher electricity bills. Google consumed 2.68 million megawatt hours of electricity in 2011. In 2016 google said it had proved it could cut total energy use at its data centers by 15% by deploying machine learning from DeepMind, the British AI company it bought in 2014 for about £400m.

There is a need to make a cloud service more profitable by reducing energy usage while at the same time keeping the service level for the customer. In this paper we want to discuss several ways found in scientific literature to achieve this goal. The easiest and most obvious way to save energy is to run fewer machines. This however comes with a trade-off. Customers expect the cloud to handle sudden increases in demand, as such it is not as simple as turning unused machines off. As a result, algorithms are needed