A SURVEY ON REDUCING ENERGY SPRAWL IN CLOUD COMPUTING

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ABSTRACT

Cloud computing is the cluster of autonomic computing, grid computing and utility computing. Cloud providers are there to rescue their customers from the problem of dynamism. The providers focus on resource sharing and in improving the performance. Energy consumption is the major factor to degrade the performance. Reducing energy sprawl will bloom the performance. This paper delineates the different techniques involved in scheduling the workload of the servers in order to minimize the energy sprawl.

KEYWORDS

Cloud computing, Energy consumption, Virtualization, Task consolidation, Virtual machine

1. INTRODUCTION

Cloud computing is a cluster of various computing and it provides the package of computer resources as a metered service. Cloud computing is an autonomic computing. The cloud providers handle the needs of their clients such as dynamism, abstraction, resource sharing. The cloud stacks are software as a service, platform as a service and infrastructure as a service. Infrastructure as a service is to provide virtualization. Platform as a service is to use the platform on web. Software as a service is directly consumed by end user. Cloud providers are there to rescue their customers from the problem of dynamism. The providers focus on resource sharing and in improving the performance. Energy consumption is the major factor to degrade the performance.

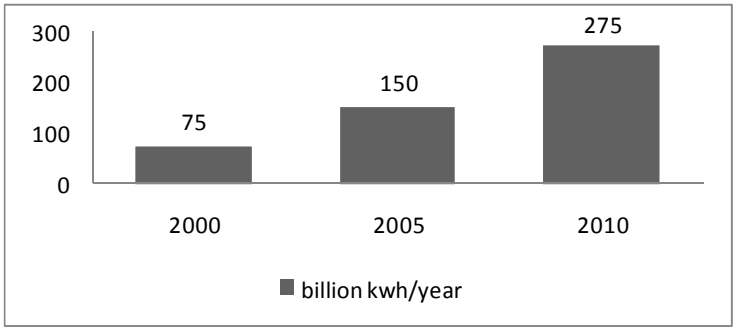

Figure 1.worldwide power consumption in data centers [7].

As shown in figure 1, the data centers have been consuming the energy raised up to 56% from 2005 to 2010 [7]. As koomey [23] spotted that, energy consumption in data centers always in hike unless energy efficient techniques are developed and applied.to address the problem of energy sprawl, to eliminate the wastage and inefficient usage of electricity in the computing resources. The additional spark for the problem is the idle servers which consume up to 70% of their peak power [24].

In this survey paper, energy harnessing techniques are discussed. The remaining paper is organized as follows: Section 2 presents overview, Section 3 presents the literature review of the existing methods of energy efficient techniques, and Section 4 presents conclusions.

2. OVERVIEW

2.1 Energy Consumption Problem

The major problem in cloud is energy sprawl. This is due to two reasons. One is manual faults like improper scheduling and work overload [5, 10] and other is due to hike in monetary cost of electricity [13]. The manual faults can be resolved by using task consolidation and virtualization. Second problem can be resolved by harnessing the renewable energy [9].The overall power consumption of the server [26] shown in figure 2.

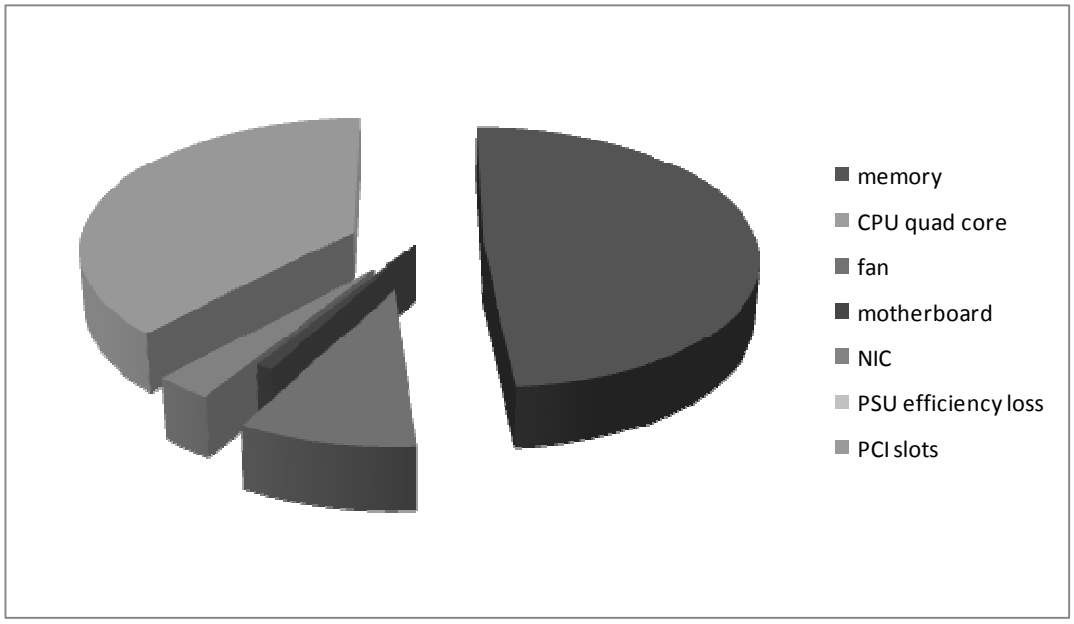

Figure 2.power consumption of the server [26].

2.1.1 Task consolidation

The task consolidation is to enhance resource utilization in a while reduce energy sprawl by assigning a set of tasks to a set of resources [21]. Task consolidation abases the amount of virtual machines, labours and energy. It aims to consolidate a set of tasks to reduce overload and also saves energy. The resource usage associated with the tasks is directly related to time constraints [11].

2.1.2 Virtualization

Virtualization technology provides the flexible resource provisioning and migration of machine state [5]. Due to hot spot, excess space capacity and load imbalance which migrates the machine. Virtualization enables the consolidation, load balancing and hot spot mitigation [4]. It allocate data center resources dynamically based on application demands and support green computing by optimizing number of servers in use. The reasons for virtualization techniques are shown in figure 3.

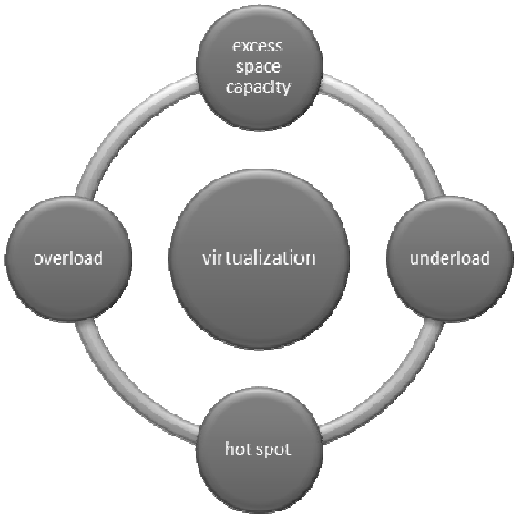

Figure 3.Reason for migrating machine.

3. EXISTING ENERGY EFFICIENT MODELS IN THE CLOUD

3.1. Probabilistic Consolidation of Virtual Machines

Jianying Luo et al. [16] shows that the virtual machine consolidation switch off the unloaded server and migrates the overloaded machine to reduce energy and server sprawl. This approach handle the multidimensional problem consolidated with respect to two resources CPU and RAM. It was consolidated by using two probabilistic procedures assignment and migration. Ad- hoc simulator is used for simulation. Assignment procedure is used for analytical study and experimented by both assignment and migration procedures. It limits the energy usage and balancing CPU bound.

3.2. Hint Based Execution of Workloads

Konstantino et al. [11] has proposed a hint based execution of workloads with Nefeli in cloud to use the energy in efficient manner. Nefeli is a virtual infrastructure gateway. Hints are deployed to collect all the information about the virtual machine. As per the hint they reschedule the virtual machine. Nefeli a high level virtual machine placement policies and it adds a layer between the user and infrastructure. During operation, Nefeli has obtained the following information such as physical node property, physical infrastructure property, current status of each virtual machine and virtual machine properties. This information is passed as a hint. The evaluation shows that the performance and energy saving is increased.

3.3. Dynamic Consolidation of Virtual Machines

Fahimeh Farahnakian et al. [19] have proposed ant colony based virtual machine consolidation which uses artificial ants to consolidate virtual machine into a reduced number of physical machines based on the current resource requests and ants work in parallel to build virtual machine migration. It composed with global and local agent. Global agent consolidates virtual machine into reduced number of physical machine. Local agent detects physical machine status. It was implemented by cloudsim toolkit. Result shows that this technique reduces the energy consumption up to 53.4% than the dynamic virtual machine consolidation.

3.4. Virtual Machine Scheduling

Dong Jiankang et al. [20] leveraged virtual machine scheduling to solve the combination of bin packing problem and quadratic assignment problem. It employs the two stage heuristic algorithm with virtual machine placement and migration. Virtual machine placement is to meet the physical capacity and network bandwidth. Virtual machine migration to minimize the migration costs to optimize the network maximum link utilization to reduce the energy consumption. c++ is used to develop the algorithm. Compared to random algorithm the energy consumption is low.

3.5. A Hierarchical Approach for the Resource Management

Bernadette Addis et al. [1] have developed a mixed-integer nonlinear optimization of resource management based hierarchical framework. It uses the resource allocation policies to allocate the resources. Local search algorithm is deployed. It was implemented by java (sun java 1.6). The result shows that hierarchal framework reduces the energy sprawl.

3.6. Tabu Search Algorithm

Federico Larumbe et al. [2] leveraged tabu search algorithm to achieve the high quality of service, low cost and low co2 emissions. It used tabu list to avoid the repeated solutions. Data centre get the power from the nearest renewable resource and grid. The tabu search algorithm shows that they find near optimal solution in short execution time and less energy consumption of 34.6 KWH than greedy approach.

3.7. Dynamic Heterogeneity-Aware Resource Provisioning

Carlo Mastroianni et al. [3] have proposed heterogeneity –aware capacity provisioning scheme which use the k-means of clustering algorithm to divide the workload into distinct classes with similar characteristics of resources and dynamically adjusting the virtual machines to minimize the total energy consumption and scheduling delay. CPU utilization and memory utilization are the parameters for evaluation. They implement this technique in matlab.

3.8. Virtual Machine Migrations

Mayank Mishra et al. [5] have proposed virtualization technology. Virtualization enables the consolidation, load balancing and hot spot mitigation. Virtualization technology provides the flexible resource provisioning and migration of machine state. Dynamic provisioning using virtual machine migration follows two steps. A first step is to deploy the virtual machine. Second step is to keep the resource monitoring engine which tracks the resource usage and performance.

3.9. Energy-aware Migration Algorithm

Mohammad H.AL Shyaeji et al. [25] have proposed an energy aware migration algorithm to save energy in which they migrates the virtual machines. An algorithm composed of three parts such as: Victim Selection, Target Server Selection, and Switch on Server. Victim selection is to switch off the under loaded machines. Target server selection is to select the machine which and where to be migrated during overloaded. Switch on server is to on the machine in sleep mode during busy periods.

Techniques and Algorithms	**Hardware / Datasets**	**Tools**	**Parameter Analysis**
Scalable distributed hierarchical framework.	Intel Nehalem dual Socket quad-core CPU @2.4 GHZ with 24 GB of RAM Running Ubuntu Linux 2011.4	IBM data center.	Energy cost
Tabu search algorithm	Hadoop cluster	C++	Number of nodes Energy cost
Heterogeneity-aware capacity provisioning scheme	Heterogeneous cluster	Matlab	CPU utilization Memory utilization
Virtualization technology.	Not mentioned	Not mentioned	Not mentioned
Energy Aware Migration Algorithm	No specific environmental set up.	Custom Built Simulator	Load Balancing, minimization of active server
Energy aware task consolidation(ETC)	Data center data sets	Cloud sim toolkit	Number of nodes Workloads
Consolidation of virtual machine	Data center data sets	Ad-hoc simulator	Number of active servers, Migrations per hour, power
Hint Based Execution of Workloads	Data center data sets	Nefeli	Energy consumption, Time consumption
Dynamic consolidation of virtual machines	Hadoop testbed	Cloudsim toolkit	Energy consumption , Number of virtual machine migration
Virtual machine scheduling algorithm .	No specific environmental set up.	C++	Energy consumption, Total communication Traffic, Maximum link utilization

Table 1. Comparison of the existing methods

3.10. Energy-Aware Task Consolidation

Ching-Hsien Hsu et al. [11] have developed a technique that reduces energy consumption is energy-aware task consolidation (ETC) technique. ETC restricts CPU use below a specified peak threshold. Task consolidation is the major work of ETC. When a task migrates to other virtual clusters considered as network latency by energy cost model. Compared ETC with MAXUTIL for evaluation. MAXUTIL is a greedy algorithm that aspires to maximize cloud computing resources. The simulation result shows that 17% improvement over MAXUTIL.

4. CONCLUSIONS

The various techniques were discussed for reducing the energy sprawl in cloud computing. The two amplifying factors are virtualization and task consolidation plays a vital role in optimizing energy consumption. Techniques like harnessing renewable energy, frequency scaling and workload consolidation enhance the performance of cloud by optimizing energy consumption. These techniques are used to resolve energy consumption problem. Thus, this survey can be used to enhance the energy consumption models by designing energy prediction models, energy optimization models and energy consumption monitors for the cloud system.

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