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ENVIRONMENTAL HIGH PERFORMANCE OF DATA-CENTERS IN GREEN CLOUD COMPUTING

[1]V.NAGALAKSHMI., [2] K.ARUNMOZHIARASAN
[1]Faculty of Computer Science, [2]HOD, Siga College of Management and Computer Science, Kappiyampuliyur, Villupuram.
vimithaak@gmail.com , arunlucks@yahoo.com

ABSTRACT

Cloud Computing is highly scalable, cost-effective infrastructure for running HPC, enterprises and Web applications. Cloud computing makes computer system behave intelligently but increases the energy consumption of data centers. Large amount of co_2 dissipation in environment has generated the necessity of green cloud computing. Obviously a substantial reduction in energy consumption is concerned with load balancing in cloud data centers. This improves the efficiency of the host machine and minimizes number of active host machine to support green cloud concept. To balance the load of entire data centre, cloud operating system known as Virtual Distributed operating system that binds the cloud approach enhancing the system performance and contribute towards the feature of green cloud computing. The green grid parameters in data centers such as Power usage Effectiveness (PUE), Data centre Efficiency (DCE) metrics are used to reduce energy consumption and co_2 emission from the data centers to lead to a environmentally friendly Green Cloud Computing method.

Keywords: Green cloud computing, energy consumption, load balancing, data center, virtual distributed operating system.

I . INTRODUCTION

Computing is designing and building hardware and software systems for the purpose of processing, structuring, and managing various kinds of information, making computer systems behave intelligently. Cloud Computing is the next generation computing operating system that is running on a single virtualized computing environment. Energy consumption is high in cloud computing as it uses more processor chips generating more heat , this heat requires cooling and cooling again generates heat and again we have to balance the system by getting same computing speed at decreased energy consumption.

The arbitrary use of cloud computing leads to wasteful energy consumption in data processing, storage and communications. One of the challenging areas in cloud computing is frequent optimization of cloud server. It mainly concerns with the load balancing of cloud data centers to improve efficiency of computing system. Provisioning cloud service while considering energy consumption criteria is called Green Cloud Computing. Data centers hosting cloud computing applications consume huge amount of energy, thereby contributing to high operational costs and carbon footprints to the environment.

Cloud computing naturally leads to power efficiency by providing the following characteristics.

1. Economy of scale due to elimination of redundancies.
2. Improved utilization of the resources.
3. Location Independence-VMs can be moved to a place where energy is cheaper.
4. Scaling up/down and in/out the resource usage can be adjusted to current requirements.
5. Efficient resource management by the cloud provider.

Fig.1 Green cloud computing environment

NEED FOR GREEN COMPUTING.

Global warming, climate change, damage of ecological resources and environmental pollution have seriously influenced and threadended man life quality and as well as health. So it is really very important for all business and industry to follow the green technology to lead a healthy life style . The goals of green computing are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability and biodegradability of defect product and factory waste. An energy aware process in the load balancing of data centers can be designed to consume energy more efficiently. Various approaches in green cloud computing are 1. Virtualization 2. Power management, 3. Material recycling 4. Tele commuting. Work on Green computing based on network include microprocessors, task scheduling algorithms, virtualization technology, cooling systems and disk storage .

2.EXISTING ENERGY EFFICIENT MODELS IN CLOUD ENVIRONMENT.

a) *Product Lifetime:* The model proposed by [ ] for product longevity includes upgradability and modularity. For instance, manufacturing a new PC makes a far better ecological footprint than manufacturing a new RAM module to upgrade an existing one. This approach leads to the product lifetime without additional resources to the existing system.

b) *Software Design*: It includes algorithmic efficiency, resource allocation, terminal servers and virtualization. The efficiency of algorithms has an impact on the amount of resources required for the computing function and writing programs. Terminal servers are also been used in green computing. With virtualization, a system administrator is able to combine several physical systems into virtual machines on one single, powerful system, thereby unplugging the original hardware and reducing power and cooling consumption.

c) *Power management*: The Advanced power Configuration and Power Interface(ACPI), an open industry standard, allows an operating system to direct control the power-saving aspects of its underlying hardware [ ]. ACPI is a successor to an earlier Intel Microsoft standard called Advanced Power Management, which allows a computer's BIOS to control power management functions. Some programs allow the user to adjust voltages supply to the CPU. This reduces both the amount of heat produce and electricity consumed. This process is called undervolting. Some CPUs can automatically under volt the processor, depending on the workload; this technology is called "Speedstep" in Intel processors.

d) *Tele Commuting*: Teleconferencing and telepresence technologies are often implemented in green computing initiatives. This results in reduction of greenhouse gas emissions related to travel, and increased profit margins as a result of lower overhead costs for office space, air conditioning, heat, lightening, etc. This is the interesting feature of green computing that greatly helps in energy consumption.

4)RECENT TRENDS IN GREEN COMPUTING.

Clouds are essentially virtualized data centers and applications offered as services on a subscription basis. So they require high usage of energy for its operation. Today, a typical datacenter with 1000 racks need 10 Megawatt of power to operate, which results in higher operational costs. The Information and Communication Technologies, (ICT) industry generates about 2% of the total global CO_2 emission. The recent techniques in cloud computing also raise the question about the environmental sustainability. Though the use of large shared virtualized datacenters cloud computing can offer large energy savings. However, cloud servers can also further increase the internet traffic by the multiple cloud server providers.

Fig 2: Green Cloud Data centers with environmental concern

The data centers in the green cloud framework is designed in such a way that its keeps track of overall energy usage of serving a user request. It relies on two major components, Carbon Emission directory and Green cloud

offers, which keep track of energy efficiency of each cloud provider and also give incentive to cloud providers to make their service "Green". The above figure represents the Green data centers that are required for the environment with green service to the user with the added feature of QoS requirements. In general, there are three types of services namely, SaaS, PaaS, and IaaS and therefore process of servicing them should also be energy efficient. In other words, cloud resources need to be allocated not only to satisfy QoS requirements specified by uses via Service Level Agreements (SLA), but also to reduce energy usage.

5) HIGH LEVEL SYSTEM PERFORMANCE.

Energy consumption is not only determined by hardware efficiency but it is also dependent on the resource management system and efficiency of application running in the system. High Power consumption results not only in boosted electricity bills but also in additional requirements to a cooling system and power delivery infrastructure, that is, Uninterrupted power supplies (UPS) , Power Distribution Units (PDU) and so on with computer components density, cooling problem becomes crucial as more heat has to be dissipated for a square meter.

6)STATIC AND DYNAMIC POWER CONSUMPTION COMS

Complementary Metal-oxide semiconductor circuits comprises static and dynamic power. Static Power consumption or Leakage power is determined by clock rates and process technology. Dynamic power created by circuit activity , that is , transistor switches, changes of values in register, etc. Dynamic Power consumption can be defined as,

$$P_{dynamic} = aCV^2f$$

Where, a represents the switching activity, C is the physical captaincy, V is the supply voltage and f is the clock frequency. The combined reduction of the supply voltage and clock frequency lies in the roots of the widely adopted DPM technique called Dynamic Voltage and Frequency Scaling (DVFS). The main idea of this technology is to intentionally downscale the CPU performance, where it is not fully utilized, by decreasing the voltage and frequency of the CPU DVFS is supported by the most modern CPUs including mobile, desktop and server system.

7) MODEL DYNAMIC POWER CONSUMPTION

Fan et al.[ ] have founded strong relationship between the CPU utilization and total power consumption b a server. This relationship between proposed system and current system is given below

$$P(u) = P_{idle} + (P_{bussy} - P_{idle}) * u$$

Where, P is the estimated power consumption, P_{idle} is the Power consumption by an idle server, P_{bussy} is the Power consumed by server when it is fully utilized and u is the CPU current utilized. The empirical non-linear model given below,

$$P(u) = P_{idle} + (P_{bussy} - P_{idle}) (2n*u^r)$$

Where, r is the calibration parameter that minimizes the square error and has to be obtained experimentally.

HIGH POWER AND ENERGY CONSUMPTION.

A recent study on Power consumption of server farms the electricity used by servers worldwide including their associated cooling and auxiliary equipment costed 7.2 billion dollars. Clearly, there are environmental issues with the generation of electricity. The number of transistors integrated into today's Intel Itanium2 Processor reaches nearly 1 billion. On comparing this expenses, DVFS creates a broad Dynamic power range for the CPU enabling extremely low-power active models.

VIRTUAL DISTRIBUTED OPERATING SYSTEM

The technology that improves the utilization of resources is virtualization of computer resources. This virtualization techniques allows one to create sereval VMs on the physical server and therefore reduce the amount of hardware in use and improve the utilization of resources. The concept originated with IBM mainframe OSs of the 1960, Commercialized for X86 – compatible computer and Open-Source projects now offer software packages to enable a transition to virtual computing. Virtual Machine is viewed as a dedicated resource to the customer.

8) DIFFERENT TECHNIQUES OF GREEN DATA-CENTERS IN IT FIELDS.

Governments around the globe usually have standards on factory or industrial facility energy consumption in IT laboratories. Some of the data center environments are discussed below.

Fig 3: Google's Green Cloud Data center in Council Bluffs, Lava.

The data center is an overhead view of the server infrastructure in Council Bluffs, Lava, houses servers in over 1, 15000 Sq. feet of space. The data center design ensures the atmosphere to reduce the emission of the carbon when compared to the traditional data centre.

Fig 4: Hauwei Cloud Data center.

The data centre of Hauwei, as shown in the figure involves network switching, routing, transmission, security, network management, products, and supports intra-data centers. There is an emission of high carbon that causes unfriendly environment.

9) DISCUSSIONS AND CONCLUSION.

The world has become highly protective about the environment with inputs from contributors such as -- Green Peace, Environmental Protection Agency (EPA) of the United States and the Climate Savers Computing Initiative, towards the use of eco-friendly energy efficient flavor of cloud computing called the Green cloud computing. Clouds uses thousands of data centers in order to process the user queries and in order to rn these data centers bulk amount of power is used for cooling and other process. The Green cloud computing endeavors to reduce the same using various techniques and algorithms. One area of research focuses on reduction in energy consumption by computer servers and other lays stress on dynamic cluster server configuration to reduce the total power consumption by balancing load and effectively utilizing only a sunset of the resources at hand.

Similarly Dynamic CPU clock frequency scaling incorporates some form of load balancing to save power consumption in data centers. The method developed by the Green Grid called Power Usage Effectiveness (PUE) metric to measure the effectiveness of the data centers.

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