Performance Analysis of Job Scheduling Algorithms for Green Cloud Data Centers

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ABSTRACT

The purpose behind schedule the development of green computing lies with the limits of its parental technology i.e. cloud computing, as the expenditures and maintenance of the infrastructure is not the only issue, but other issues include its environment-unfriendliness, enormous energy expenses and the extensive radiation of heat and carbon compounds out of the data centers due to the numerous cooling servers installed and are functional inside them. So, the cloud service sellers improvised the cloud technology, ensured that all these problems of cloud are overcome by the newer technology and then, finally named it 'Green Computing' The technology of cloud computing sorts use of the huge data centers that present multiple issues such as wide-ranging amounts of energy consumption, dissipation of lots of heat and methane, carbon dioxide, etc. like deadly green-house compounds and gases. In direction to solve all the above specified issues of cloud computing, green computing came out as an enhancement over the conventional cloud technology with energy-efficiency, security and environmental-friendliness. The two of the Linear power model and the Low Power blade model are the present ones, which employ four Virtual Machine scheduling algorithms for the calculation of consumption of power. The research work is inspired to evaluate performance of Virtual Machine scheduling algorithms with two existing power models on the Green Cloud Simulator.

Keywords: Telecommunications Industry, Cloud Computing Architecture, Service Models, Infrastructure as a Service (IaaS)

1 INTRODUCTION

enabled to a shared pool of configurable computing resources for network access on-demand, ever-present, convenient(e.g., networks, servers, storage, applications, and services)Cloud computing is a model that can be rapidly provisioned and released with minimal management effort or service provider interaction.The increase in demand of new users for accessing applications in public and personal level. Personal level like social networking which produce a huge work load and public level includes private corporations and public organizations. To manage load technology like virtualization had evolved which had made computing more compelling than previous years. A recent studies shows power consumption of server from across the world which includes power consumption by the auxiliary equipment's and cooling system is around US $7.2billion [13].

1.1 Telecommunications Industry

is currently under pressure arising from deregulation, competition and rapid technology change, especially in the era of cloud computing. Cloud Computing is a broad but fledgling area spurred by several important technological trends. The most important trends underlying all cloud offerings are [1]

1) Ubiquitous network connectivity and
2) Virtualization

The general aim of software-defined networking (SDN) and Network Functions Virtualization (NFV) is to deliver functions, networks and infrastructure as services rather than as features of vertically integrated systems. Cloud computing enables telecom operators to offer communication services at reduced price for subscribers and ability for serving the next generations of terminals like smart phones, tablets, and new generation wearable devices. Cloud computing provides a new business opportunity for Telecom Service Providers (TSP)who are well positioned to combine cloud computing services with securely managed networking to meet the customer requirements for secure and high performance cloud services [2].

1.2 Role of Telecommunications in Cloud Computing

delivering multiple services to the customers with defined quality of service and optimal resource allocation requirements The telecommunications network is a central part of cloud architecture which. This role is well positioned to deliver a wide range of services including telecom grade cloud platform and services, integrating services, data centers and IT network infrastructures with end-to-end quality of services. The role of telecom in cloud computing eco system can be classified as operational roles and technical roles, as listed below [6]

1.3 Cloud Computing Architecture

The cloud architecture broadly has two blocks the front end and back end. Both of them are connected to each other through network required to access the cloud computing system The front end includes the user computer and the application. Not all cloud computing systems have the same user interface. Services like Web-based e-mail programs leverage existing Web browsers like Internet Explorer or Firefox. Servers and data storage systems that create the "cloud" of computing services, On the back end of the system are the diverse computers. A central server administers the system, monitoring traffic and client demands to ensure everything runs smoothly. A set of rules it follows called protocols and uses a unique type of software called middleware. Middleware allows networked computers to communicate with each other. If a cloud computing company has a lot of clients, there's likely to be a high demand for a lot of storage space. Thousands of digital storage devices wanted some companies .at least twice the number of storage devices Cloud computing systems need it requires to keep all its clients' information stored. A cloud computing system must make a copy of all its clients' information and store it on other devices. to access backup machines that otherwise would be unreachable The copies permit the central server to retrieve data. Making copies of data as a backup is called redundancy.

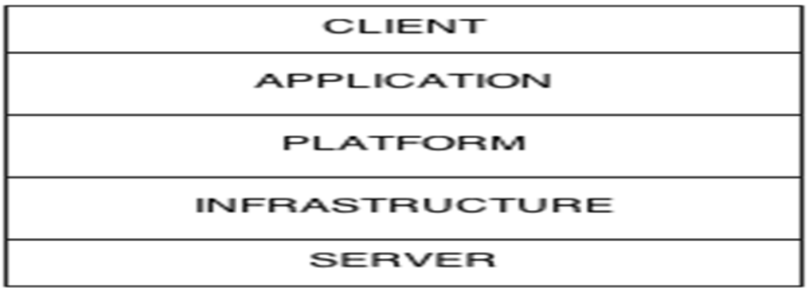

Figure 1.1: Cloud Computing Architecture

1.4 Service Models

Cloud computing has three service models on which whole cloud computing relies. It incorporates Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), and provides these services like utilities, so the end users are billed by how much they used.

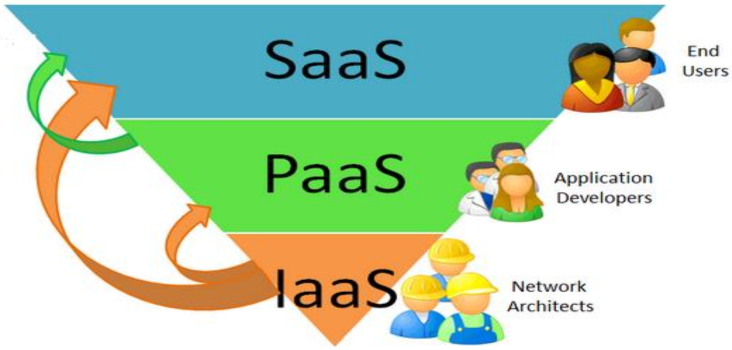

Figure1.2: Service Models

1.4.1 Infrastructure as a Service (IaaS)

Infrastructure as a service (IaaS) provides infrastructure to users. The infrastructure could be in terms of data storage space, or consumer computing services which can be used by user to run or install arbitrary software's. The infrastructure such as operating system, storage disks and other software's installed on user system can be managed by consumer [5, 27].

1.4.2 Platform as a Service (PaaS)

Cloud also provides application for the users on the infrastructure of service provider. By using paas user is deployed onto cloud. The platform can be some specific operating system or some driver. These are custom applications which are created in some programming language, services, and tools from service providers. Applications can be from consumer or acquired applications. The user does not control cloud infrastructure but he can customize applications. Example: Amazon web services [5].

1.4.3 Software as a Service (SaaS)

It provides user to get access to some of the applications on cloud. Service providers will deploy applications on internet the client will search for the best service according to their needs and use the service. The consumer will be able to access the software only when he is connected to internet. The user will be able to customize application according to the requirement. Some of the software as a services are free and some are paid. The paid services are based on pay as you go model. The pay as you go services are much secured than free services because of the SLA which is signed between the user and the service provider. The client needs not to control the cloud infrastructure. The user applications can be accessed either by interface or with the help of thin clients [5].

2. RELATED WORK

The research work performed in this area by different researchers is presented as follows:

Akhil Behl et al. [1] had focused on security challenges in cloud environment. The author says that Loop hole in the security of any component in the cloud can be both disasters for the customer and defacing for the service provider. The paper discusses the security issues related to the cloud there are many security threats which emerge inside or outside of cloud provider's/consumer's environment and these can be broadly classified as Insider threats, outsider malicious attacks, data loss, issues related to multi-tenancy, loss of control, and service disruption. The paper also discusses the existing security approaches to secure the cloud infrastructure and applications and their drawbacks

Anne-cecileorgerie et al. [2] the focus of the paper is on consumption of energy by different servers like IBM e server 326, sunfire v 20z and HP proliant. The paper has shown various results on the basis of the consumption of energy by machines. Various criteria have been adopted in the paper like consumption of energy by six servers running typical application, energy consumption in idle state etc. It also provide some information on power management using components like CPUs, Hard drive, fans, Ethernet adapters. Consumption of power of disk is composed of fixed proportions, whereas dynamic portions include I/O workload, data transfer, which represents about 1/3 of consumption. The author had also discussed about ON/OFF technique with which we could turn OFF/ON our datacentre upon requirement, as compare to OFF stage the power consumption at idle state is much higher. HP Prolient server consumes 10% energy at idle state

Chao-En Yen et al. [3] describes Roystonea, a hierarchical distributed cloud computing system with pluggable component architecture. The component plug ability gives administrators the flexibility to use the most appropriate subsystem as they wish. The component plug ability of Roystonea is based on specifically designed interfaces among Roystonea controlling system and infrastructure subsystems components. The component plug ability also encourages the development of infrastructure subsystems in cloud computing. Roystonea provides a test bed for designing decision algorithms used in cloud computing system. The decision algorithms are totally isolated from other components in Roystonea architecture, so the designers of the decision algorithms can focus on algorithm design without worrying about how his algorithm will interact with other Roystonea components.

The author Linlin Wu et al. [4] to achieve the required service efficiently when negotiating with multiple providers proposed a novel automated conciliation framework where a SaaS broker is utilized as the one-stop-shop for customers. The automated negotiation framework facilitates intelligent bilateral bargaining of SLAs between a SaaS broker and multiple providers to achieve different objectives for different participants. To maximize profit and improve customer satisfaction levels for the broker, we propose the design of counter offer generation strategies and decision making heuristics that take into account time, market constraints and trade-off between QoS parameters.

The author Liang Lou et al. [5] had analyzed the consumption of cloud cluster. The overall energy consumption includes server, switching, storage, and others. The author had given a formula for calculating energy which includes all components resulting into E_{cloud} .The author had given two parameters as job classification and type of policy with policy type we can regulate the components to achieve the purpose of saving energy. In the algorithm there are three phases infrastructure preparation phase in which resource stats counts all hardware of cloud environment, the energy phase counts energy consumption and adjustments of components and lastly scheme settlement phase which uses different policies.

Doina Bein et al. [6] had given an example of one of the aspect of cloud computing which is gaming. For that AMD was developing commercial supercomputer with 1000 graphic processing unit (GPU). The super computer named as "fusion render cloud" which will run graphics rendering software to deliver 3D real time animation through browsers. In the paper author had described algorithm for storing data with minimum cost. In that it had taken memory of server equals to 1 since the memory is limited and fixed. The data size should be much larger than zero. It uses Bin packing and framing the data into larger size blocks called chunks. For evaluation the two algorithms had been considered by the author they are $HARMONIC_M$ and CARDINALITY CONSTRAINED Harmonic. The author had modified the algorithms in terms of storing larger request more than the memory size of single server. The extended algorithm in the paper for larger request is termed as HLR ($HARMONIC_M$ with larger request) and CCHLR (CARDINALITY CONSTRAINED HARMONIC with larger request).

Chonglin Gu et al. [7] In a cloud data center, servers are always over-provisioned in an active state to meet the peak demand of requests, wasting a large amount of energy as a result. One of the options to reduce the power consumption of data centers is to reduce the number of idle servers, or to switch idle servers into low-power sleep states. However, the servers cannot process the requests immediately when transiting to an active state. There are delays and extra power consumption during the transition. In this paper, we consider using state of-the-art servers with multi-sleep modes. The sleep modes with smaller transition delays usually consume more power when sleeping. Given the arrival of incoming requests, our goal is to minimize the energy consumption of a cloud data center by the scheduling of servers with multi-sleep modes. We formulate this problem as an integer linear programming (ILP) problem during the whole period of time with millions of decision variables. To solve this problem, we divide it into sub-problems with smaller periods while ensuring the feasibility and transition continuity for each sub-problem through a Backtrack-and-Update technique. We also consider using DVFS to adjust the frequency of active servers, so that the requests can be processed with the least power.

K. Sutha et al. [8] an efficient job-scheduling algorithm is required to reduce energy consumption and execution time without diminishing performance of the system. Apart from this, a green cloud data center plays a significant role in cloud computing to reduce Co2 emissions. Energy-efficient heuristics model is used to find an optimal solution for executing jobs of varying sizes and timings. In this paper, using Dynamic Voltage Frequency Scaling (DVFS), we introduce Energy-Efficient Job Scheduling (EEJS) algorithm to green cloud data centers. Our proposed algorithm is compared to Energy-Conscious Scheduling algorithm (ECS) and Green Energy-Efficient Scheduling algorithm (Green-EES).

3. PROPOSED WORK

Among the various techniques for saving energy of the physical infrastructure one of the technique is virtual machine migration, the state of creating virtual machine is related to virtualization which creates identical images and provide heterogeneity and we can deploy various machines on single machine. In order to balance load on various systems virtual machine migration is used and we could save energy by turning OFF the idle machines.

The evaluation of Greencloud on the basis of the two models it had used in for energy calculation, the Linear power model and Power blade model. In the two models we used four different scheduling algorithms the Green scheduler, Green scheduler using virtual machines, Round-Robin scheduling using host and Round Robin using virtual machines. The green cloud is based on three tier architecture which uses L3/L2 switches in its layers. We have used one switch in core network layer two in aggregation layer and 144 physical machines in its last layer. The PMs are arranged in TOR topology which uses switches either L2 or L3.

4. RESULTS AND ANALYSIS

In this section we will show the working of green cloud simulator, the simulator works with Ubuntu 12.04 and above, we have used 12.04 versions in it. Firstly go into the terminal and write cd greencloud + enter this will move into the green cloud directory. After you entered the directory to compile the code after the changes you have performed use command "make" this will compile all those codes in which the changes you have performed. The make command is executed in the next image. You can also clean the previous compilation by using the "make clean" command first and then using "make" command run. The compilation is needed only when the changes are performed in the C++ files, there is no need to compile when the changes are performed in the TCL files After compiling the code use command "./run" to run the code.

The out will be displayed in the firefox browser as shown in figure 4.1 the output will contain summary of simulation in the form of pie chart. The details are also shown with duration of simulation, architecture used, task allocation total and average number of task per server, load on datacenter and energy consumed by transmission media and server.

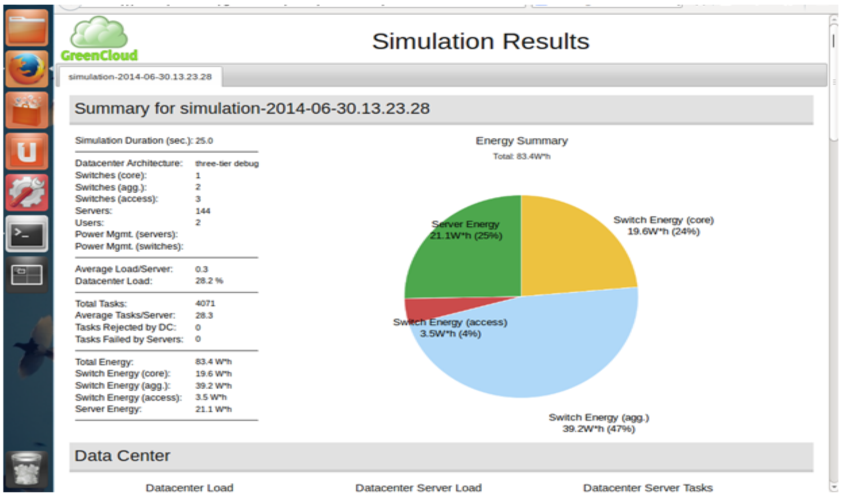

Figure 4.1: Output after executing the program using power blade model

The graphical representation of different power models with different scenarios as scheduling algorithms is shown in graphs the parameters are total energy, energy consumption from switches, server energy, simulation time, task rejected by datacenter and task failed by server. From the results the energy saved by power blade model is almost 1/3rd of the liner power model. During the simulation it has been encountered that some task were rejected by the datacenter and some failed to complete. The energy consumption by these schedulers is low but at the same time numbers of tasks submitted were quite less and lot of tasks failed to complete the scenario. This is clear that it will violate service level agreement (SLA) and moreover it hampers the Quality of service (QoS) parameter. In the end there are two tables which gives two scenarios which shows some important parameters for energy efficient cloud computing.

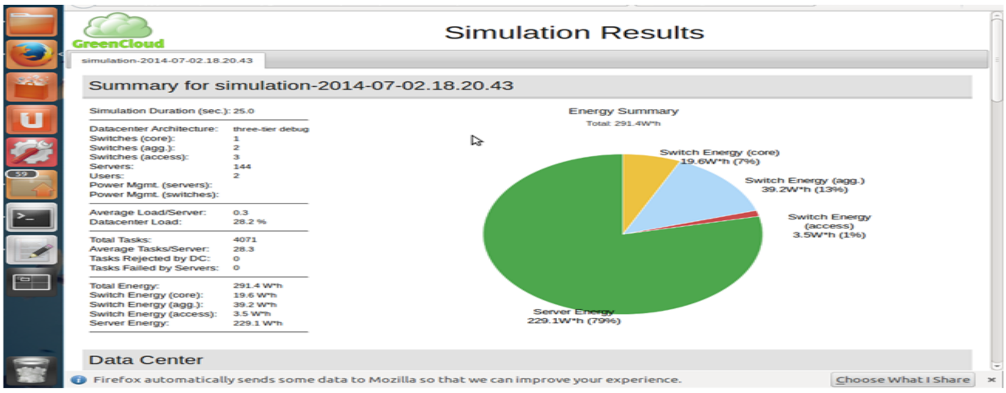

Figure 4.2: Output after executing the program using Linear Power Model

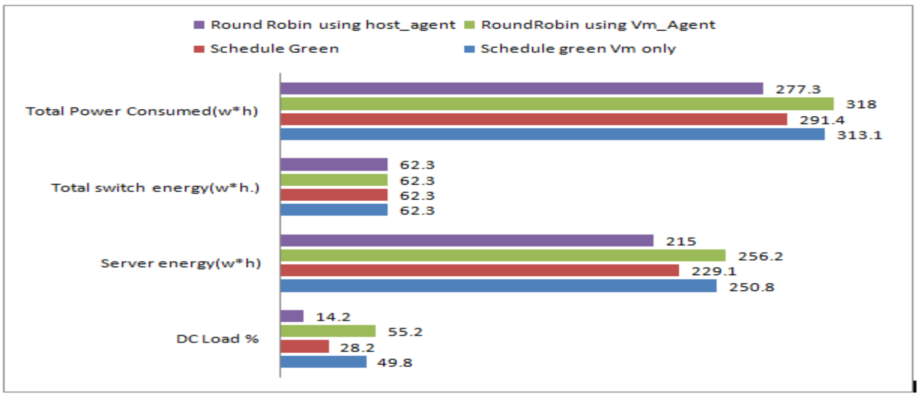

Figure 4.3: Power Consumption in Linear Power Model

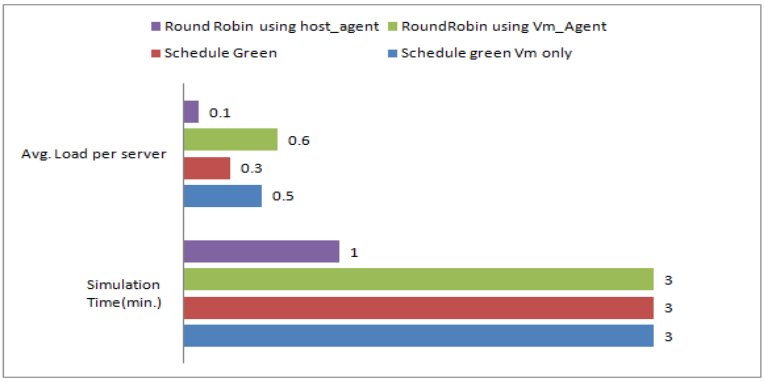

Figure 4.4: Load and Time Of Linear Power Model

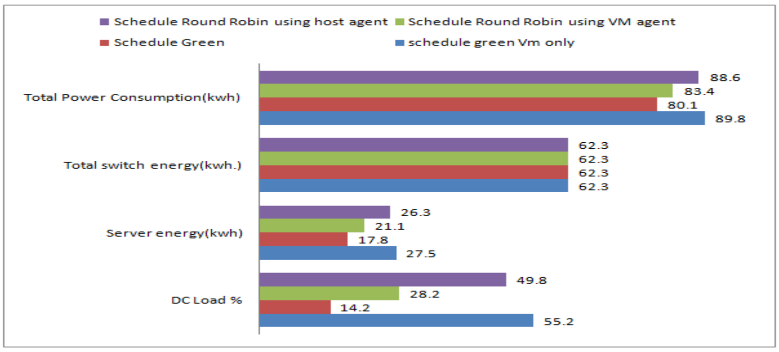

Figure 4.4: Power Consumption in Power Blade Energy Model

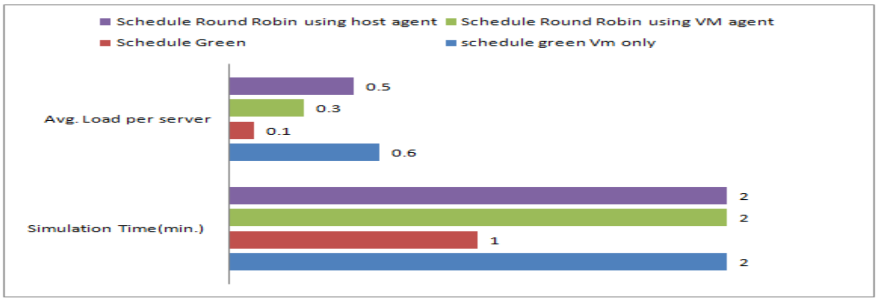

Figure 4.5: Load and Time Consumed In Power Blade Model

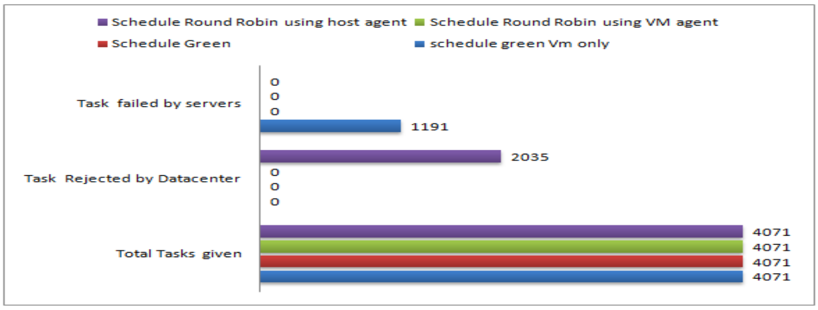

Figure 4.6: Tasks Failed and Rejected

Table 4.1: Comparison between various algorithms using Linear Power Model

SCENARIO 1

Algorithms	Total Tasks Given	Tasks Completed	Task Rejected By DC	Task failed by server	Total power consumed
RR using VMs	4071	4071	0	0	318
RR using host	4071	2036	2035	0	277.3
Green scheduler	4071	4071	0	0	291.4
Green scheduler using Vms	4071	2880	0	1191	313.1

Table 4.2: Comparison between various algorithms using Power blade Model

SCENARIO 2

Algorithms	Total Tasks Given	Tasks Completed	Task Rejected By DC	Task failed by server	Total power consumed
RR using VMs	4071	4071	0	0	88.6
RR using host	4071	2036	2035	0	83.4
Green scheduler	4071	4071	0	0	80.1
Green scheduler using Vms	4071	2880	0	1191	89.8

5. CONCLUSION AND FUTURE SCOPE

Cloud computing has grown-up so fast that it had made almost every organisation rely on it. Since the time it had developed and now there is vast technological change in the field. It requires huge effort to build a technology that could help consumers as well as service providers. Currently we are facing energy as a challenge in the field because due to steep increase in demand the deployment of hardware infrastructure is being deployed at pace. This infrastructure not only consume electricity by itself it also need auxiliaries which also consumes electricity in order to keep the temperature down for these machines.

In our work we have evaluated the energy consumption using different and different power models. The traditional linear model and power blade model with two algorithms each with two different scenarios. The intake of energy varies a lot and moreover we saw two abnormalities as task rejection by data center and task failed on servers which is an issue. In our future work we'll try to fix these problems and we can formulate strategies to minimize the power consumption, better task allocation strategies in future for fine consumption of resources.

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