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PERFORMANCE ANALYSIS OF SCHEDULING ALGORITHMS UNDER SCALABLE GREEN CLOUD

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***Abstract**: The development of computing systems has always been focused on the performance improvements driven by demands of applications. The energy consumption of computing systems has limited the performance growth because of energy consumption and carbon dioxide emissions. Therefore the aim of computing systems has been moved from performance improvements to energy efficiency. Among the various techniques for saving energy of the physical infrastructure, one of the techniques is Virtual Machine Migration, the state of creating virtual machine is related to virtualization which creates identical images and provides heterogeneity and we can deploy various machines on a single machine. In order to balance load on various systems, virtual machine migration is used and we can save energy by turning off idle machines. This paper proposes a mechanism that would contribute to energy consumption and analysis of performance of scheduling algorithms under different power models i.e linear power model and power Blade model. The Green cloud simulator is used which is extended from network simulator. The simulator compiles two languages C++ and tool command Language with core code written in C++ and tcl supports the front end and it creates the traces of simulation which includes the parameters involved in it.*

1. INTRODUCTION

Cloud computing is a model for convenient and on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction. Cloud computing achieve multi-level virtualization and abstraction .Therefore a lot of new applications are deployed on internet every day and numbers of people using these services are growing rapidly. 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. In the study it has been observed that the consumption had been doubled since year 2000. These surveys has given birth to a new advocacy called green computing which is growing with the aim to make the system energy efficient and efficient utilization of resources. Studies shows average utilization of data centres can be nearly 20% and energy consumed by the idle resources is can be as much as 60% of the peak power.

Virtualization technology improves power efficiency of data centres by enabling the assignments of multiple Virtual Machines (VM_s) to single server. The assignment of multiple Virtual Machines helps in consolidating the task and turning off other physical machines there by lowering the consumption of energy. Another way for green computing is through service level agreement SLA_s which is established between the service provider and the consumer before allocation of infrastructure. The SLA could be related to storage space, bandwidth, and power consumption. On basis of performance SLA could be related to service time and Quality of Service.

Virtual Machine Migration (VMM) is another green computing technique for efficient usage of resources. The VMM technique migrate virtual machines from one machine to another this will help in distributing load from one physical machine to another. After the CPU utilization decreases it will migrate the VM back to the machine and turn off the second machine. This helps in lowering the electricity consumption by

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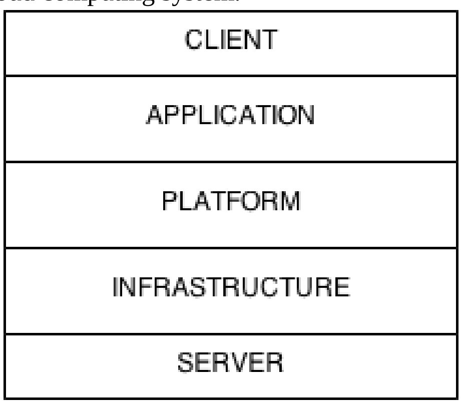
physical machines. Since the machine will consume energy when required else it is turned off. VMM could be done by using different algorithm like first fit, montecarlo, round robin etc.

1.1 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. The front end includes the user computer and the application required to access the cloud computing system.



In the cloud the ultimate repository does not lie with single server, rather it is distributed. Example web hosting allows user to save their data on web. The cloud provides basic essentials as low cost and efficient storage management. Still it has been shown by the hackers that they can intrude into the network. Various threats can be seen from within or outside. Threats within organization might occur from lost smart phones and notebooks of employees. But now days the hacker use virtual network as a platform for hacking or there might be some espionage within the organization for the security breech. The threat from outside might not be that harmful as from within the organization.

2. RELATED STUDY

Akhil Behl[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 .The paper also discusses the existing security approaches to secure the cloud infrastructure and applications and their drawbacks.

Anne-cecileorgerie et. al [2] 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 data centre 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.

Anton Beloglazov et al.[3] consider other issues like in sufficient cooling system which leads to reducing system reliability and devices lifetime. Co_2 emission is caused due to high power consumption by cloud infrastructure. The author presents decentralized architecture of resource management in which there are three layers called dispatcher, global manager and local manager. The local manager looks after the CPU utilization and thermal state. Any of the feature is tend to gets violated the local manager inform the global manager. The different conditions are when CPU utilization is near to 100%, underutilization of resources and high temperature. The decentralization removes single point failure and improves scalability. Moving towards allocation policies it had divided the VM reallocation in two parts

Anton Beloglazov et al. [4] had given architectural framework of cloud computing in which the cloud environment has consumer, green service allocator, virtual machines and physical machines. The green service allocator includes green negotiator, service analyzer, consumer profiler, pricing, energy monitor, service scheduler, VM manager accounting. It also includes modified best fit decreasing algorithm for allocation of VMs. This allows leveraging heterogeneity of resources by choosing most power efficient node first. The minimization migration policy minimizes number of migrations. This has the upper threshold and lower threshold limit.

Chao-En Yen et. al[5] 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.

Damien Borgetto et al. [6] focuses on the three methodologies which include virtual machine migration, reconfiguration and power management. The author aims for minimizing the energy consumption and service level agreement (SLA) violation. During the implementation it tries to control migration, energy cost and scalability. The paper had used allocation and reallocation policies on the basis of four different algorithms First Fit, Montecarlo method, Round Robin and vector packing. In PM power management it had considered all PMs Empty in current iteration which means that there is no virtual machine gets allocated. Some of the empty machines will be turned off say *a* i.e. when all the machines will be empty it will turn off all the machines except one. One physical machine will remain on so that sudden rise in the utilization could be managed easily. With powering on the physical machine it defined a rule based approach resource dependent threat threshold TT. Number of machines can be turned on whenever TT increases above average level .

Doina Bein et al. [7] 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 $HARMONIC_k$. 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 $HARMONIC_k$ with larger request).

Gurudatt kulkarni et al. [8] had discussed about service model which includes infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS). The focus is on security in cloud computing, the author suggests the cloud computing based separate encryption and decryption service from the storage service. Due to the increase in requirement of cloud service it becomes an important issue to handle data safely. The cloud computing is getting a lot of attention and in this paper the author look at the ways in which security threats can be danger to cloud environment and the techniques to avoid these threats. Different issues with service providers are identity and access management, privacy, securing data during transmission, user identity, audit, and compliance. Security issues related to infrastructure are secure data storage and network and server. Lastly end user security issues are security as a service, browser security authentication, loss of governance, data protection etc.

Hadi Goudarzi et al. [9] had taken a problem of energy efficient virtual machine placement in cloud computing system. The author had presented an approach that first creates multiple copies of VMs and then use dynamic programming and local search to place the copies on physical servers. The operational cost of the system is assumed to be total energy cost of serving all clients request. The VMs represents client on physical machines, the workload prediction helps in determining amount of resources required. Multiple copies of VMs are distributed to various servers which will be distributed using upper bound in order to increase quality of service.

Jian-Sheng Liao et al. [10] converges the attention to energy efficient resource provisioning with guaranteed SLAs. In the paper the author proposed an architecture which considers user’s SLA requirement. The SLA will contain duration for customer, in order to minimize energy consumption. The architecture will have four layers internet, application layer, resource management layer and data center layer. The workflow of system will have an application request from customer, it will be send to cloud provider and finally to datacenter. The studies focus on computational and non computational and non computational jobs such as web servers, storage servers and so on. Whenever the SLA is violated the P penalty will be charged according to the algorithm. It had compared two different approaches round robin and SLA based resource constraint VM consolidation. Some data shows different energy consumption by different resources which include the major components like CPU which consumes 58% of power, RAM consumes 28% and 14% by disk.

The author Kejiang Ye et al [11] had given energy efficient datacenter architecture. The architecture consisted of four main modules. Out of four the author had focused on energy management module and monitoring module. The monitoring module is responsible for monitoring both virtual machines and physical machines including the power consumption, resource utilization etc. Management module is responsible for all management issues in datacenter cloud, which includes energy management sub module, security management sub module etc.

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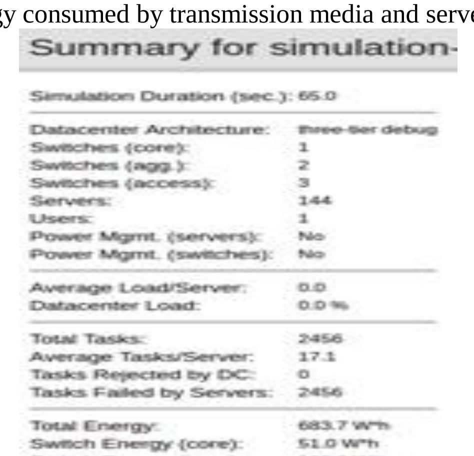
3. PROPOSED WORK

Some tools are developed by different researchers such as Green Cloud simulator developed by Luxembourg University, Cloud Sim simulator by Melbourne University. I have used the Green cloud simulator which is extended from the network simulator. The simulator compile two languages C++ and tool command language (tcl) with core code written in C++ and the tool command language supports the frontend and moreover it creates traces of the simulation which include the parameters involved in it. The evaluation of Green Cloud 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. From the simulator we can select which algorithm we have to use at a particular instance and can choose the appropriate power model. The number of servers and switches can be customized and the number of users can also be fixed.

4. RESULTS AND DISCUSSIONS

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 version in it. After compiling the code, the output will be displayed in the Firefox browser. 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.



Summary for simulation

Simulation Duration (sec.): 65.0

Datacenter Architecture:	three-tier debug
Switches (core):	1
Switches (agg.):	2
Switches (access):	3
Servers:	144
Users:	1
Power Mgmt. (servers):	No
Power Mgmt. (switches):	No
Average Load/Server:	0.0
Datacenter Load:	0.0 %
Total Tasks:	2456
Average Tasks/Server:	17.1
Tasks Rejected by DC:	0
Tasks Failed by Servers:	2456
Total Energy:	683.7 W*h
Switch Energy (core):	51.0 W*h

Figure 1.1: Output after executing the program without power models

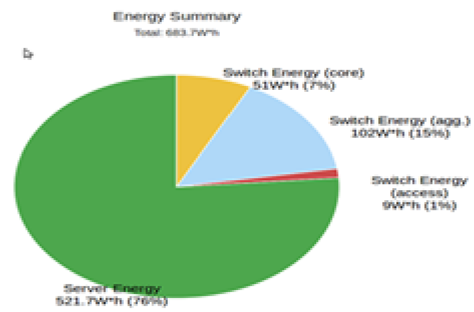
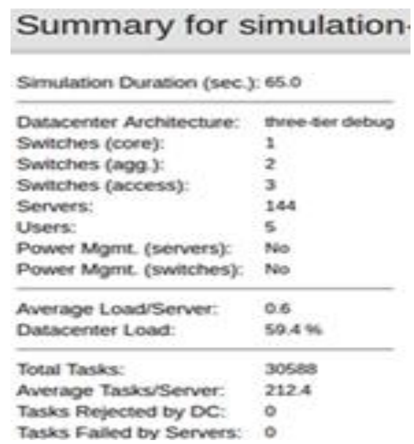


Figure1.2: Energy Graph without Simulation

After applying the power models to the algorithms, the tasks rejected by the data centre and server get reduced to 0 as shown in figure below.



Summary for simulation

Simulation Duration (sec.): 65.0

Datacenter Architecture:	three-tier debug
Switches (core):	1
Switches (agg.):	2
Switches (access):	3
Servers:	144
Users:	5
Power Mgmt. (servers):	No
Power Mgmt. (switches):	No
Average Load/Server:	0.6
Datacenter Load:	59.4 %
Total Tasks:	30588
Average Tasks/Server:	212.4
Tasks Rejected by DC:	0
Tasks Failed by Servers:	0

Figure 1.3: Output after executing the Round Robin Scheduling Algorithm using VM under Linear power model

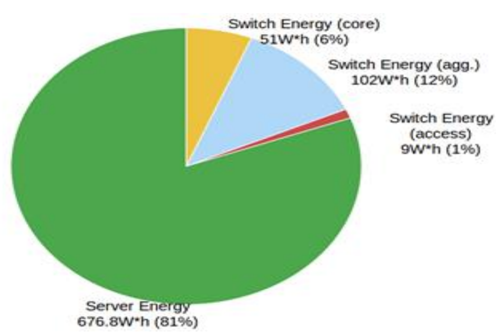


Figure1.4: Energy Graph after executing the Round Robin Scheduling Algorithm using VM under Linear power model

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 data centre and task failed by server. From the results the energy saved by power blade model is almost $1/3^{rd}$ of the liner power model. During the simulation it has been encountered

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that some task were rejected by the data centre 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.

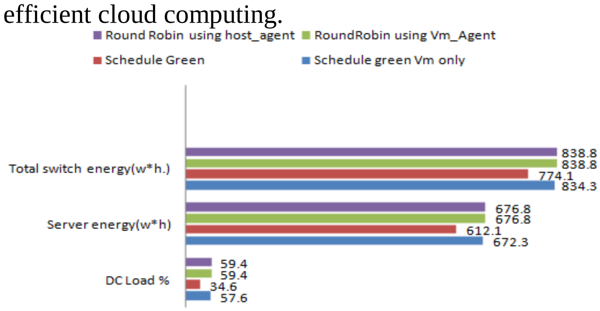

Figure1.5: Power Consumption in Linear Power Model

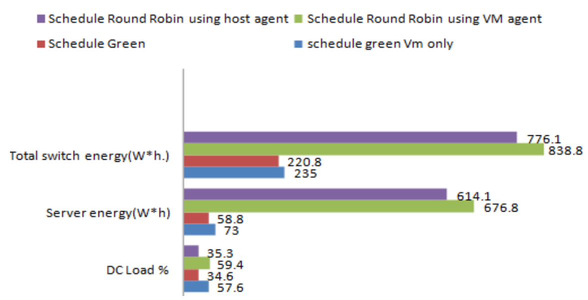

Figure1.6: Power Consumption in Power Blade Model

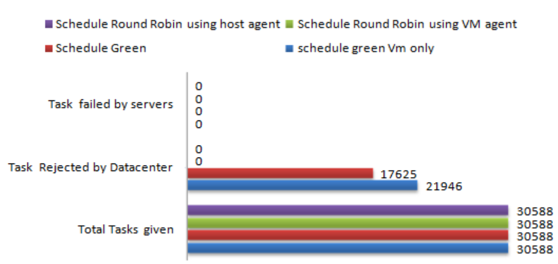

Figure 1.7: Tasks Failed and Rejected in Linear Power Model

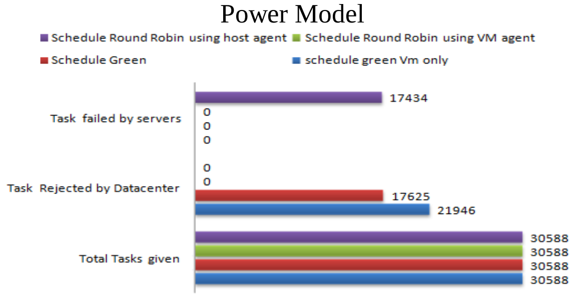

Figure1.8: Tasks Failed and Rejected in Power Blade Model

Algorithms	Total Tasks Given	Average Tasks per server	Task Rejected By DC	Task failed by server	Total energy consumed(W*h)
RR using VMs	30588	212.4	0	0	838.8
RR using host	30588	212.4	0	0	838.8
Green scheduler	30588	212.4	17625	0	774.1
Green scheduler using Vms	30588	212.4	21946	0	834.3

Table1.1 Comparison between various algorithms using Linear Power Model

Algorithms	Total Tasks Given	Average Tasks per server	Task Rejected By DC	Task failed by server	Total energy consumed(W*h)
RR using VMs	30588	212.4	0	0	838.8
RR using host	30588	212.4	0	17434	776.1
Green scheduler	30588	212.4	17625	0	220.8
Green scheduler using Vms	30588	212.4	21946	0	235

Table1.2 Comparison between various algorithms using Power Blade Model

5. CONCLUSIONS

Cloud computing has grown 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 this paper 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 consumption of energy varies a lot and moreover we saw two abnormalities as task rejection by data centre and task failed on servers which is an issue.

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