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Energy Efficient Load balancing Algorithm for Green Cloud

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***Abstract*- Increasing energy costs and environmental impact of the various sources also increasing the need of energy efficient computing. Avoiding the hardware resources and the use of sophisticated software solutions for reducing the energy consumption is an important area of research. Cloud Computing is an emerging technology because of its ability to hold many existing technologies on a single platform. And this is achieved by virtualization. Energy efficient software programs working on the Cloud computing system. In this paper, we examined the various applications of energy efficient load balancing of virtual machines working on Cloud. And we have proposed our algorithm where the scheduler distributes the load to virtual machines having temperature aware resource scheduling which is far away from its critical temperature and also less power consumption.**

Keywords- Resource scheduling, Task scheduling, Thermal management, critical temperature, power efficiency.

1. INTRODUCTION

Cloud Computing is an emerging new paradigm for large scale distributed computing. Computing and data has been migrated from desktop's and PC's into larger data centers[1]. Big organizations are adopting Cloud Computing for enhancing their performances, availability and reducing cost associated with applications. Cloud Computing being as a service model classified into Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service (SaaS) and Security as a Service(SEaaS). These four layers are combined on a single platform which is managed by virtual machines(VMs). VMs creates an illusion of a dedicated computer system. As per the end users demands , the host creates the Vms as a result load also increases and is the load exceeds the from the threshold values allotted to each of the machines the efficiency will be affected. So balancing the power of data centers is a tedious task . It has been surveyed that data centers consumes 0.5% of worlds total electricity usages till 2014[2]. In 2010 1.5% of total energy consumption of data centers in US are increasing every year[2]. Cloud Computing is reducing the energy consumption because of using the VM and its proper migration during load balancing.

High power consumption by the data centers emits huge amounts of carbon dioxide($C0_2$). So there is a need of energy aware load balancing techniques for Cloud Computing[3]. High performance in the Cloud can achieve by various methods such as improvement in software applications, virtualization of computing resources, dynamic voltage frequency scaling (DVFS) and by using energy efficient hardware. With the enhancing demand of Cloud Computing the dependency on power also increasing as life of a computer system is directly related to its operating temperature. With the use of limited energy resources Cloud Computing is adopting the concept of green computing environment.

A Cloud Computing cluster provides various VMs which are controlled by some hypervisor. When any task arrives to the cluster the load scheduler allocates the job with a preconfigured VM activated by host. After job is executed, the virtual machine comes under deactivate mode [5].

In this paper we are extending the implementation of energy aware load balancing algorithm for high performance cluster Cloud Computing where VM are allocated for job execution after checking the threshold temperature. It will either further balance the task or it will migrate the task to another VM which can be a green solution.

A. Green Cloud

Green cloud is a buzzword that refers to service delivery model over internet having some environmental benefits. Data centers of Cloud are more efficient than traditional data centers which are using green . According to the recent Microsoft report Cloud Computing can help with energy reduction through deploying the large scale of virtualization. Some of the characteristics are

B. Large Scalability

Green cloud works on a very large scale like Google, Amazon, IBM cloud and having more than one million services with infinite users. Green cloud computing enables user to get services everywhere and everywhere.

C. Good Reliability

With the effective fault tolerance, Cloud has the higher reliability of the service. The use of Cloud computing is more reliable than any local desktop computer.

D. Versatility

Applications are run on platform independent environment with good accuracy and effectiveness.

E. Service on demand

Green Cloud is the on demand service because it is sharing a big resource pool that the users can buy according to their requirement.

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II. RELATED WORK

With the rapid enhancement in cloud users , the negative environmental effect has also increased steadily and thus by maintaining a high quality of service(QoS) in Cloud System, minimization of energy consumption is also a vital task[6][7]. Leonard Klienrock[7] an American Scientist has already given the idea of computation utility and it came into reality with coming of Cloud Computing.Buyya et.al[8] proposed framework of market oriented resource management. Mukherjee and Sahoo[9] have done various research and proposed various framework of green cloud for efficient load balancing or task scheduling. Anton Beloglazov et al.[10] has proposed some policies of resource management for virtualization centers where the load balancing will be done due to the VM migration according to the set threshold value of each data center. Andrew J Younge et al[11] have focused on enhancing data centers efficiency by using power aware techniques for load balancing which will increase the effective live migration of the VMs, proper resource management and overall system efficiency. Orhan Dagdeviren[12] proposed some cluster based model for task scheduling in green cloud. Ting Yang et al[13] has proposed an algorithm called virtual machine placement and traffic configuration algorithm(VPTCA) that aims to reduce the Data Center Network(DCN's) energy consumption by assigning the co related VMs into same server which will help to minimize the amount of transmission load. PaulinFlorence[14] has proposed energy aware load balancing (EALB) computational cloud.

The algorithm focussed on incoming job request to the respective behaviour by using the table driven approach organised as hash table format. MteuszGuzek et al.[15] has propose a novel load balancing model for the energy efficient resources allocation in hetrogenous systems which is based on DENS[16] and estab[17].Jun Yang et al.[18] proposed OS level framework that perorms thermal aware task scheduling to reduce the number of thermal passes. The load scheduler decreases the amount of hardware usage efficiently.

III. PROPOSED WORK

Job scheduling in Cloud Computing is different from other scheduling problems (like DNS load balancing) as its shares the load globally to the servers. Unlike other load balancing schemes Cloud computing load balancing provides users to the closest regional server with any obstacle to the user.

In this paper load balancing or task scheduling technique is proposed which works on power consumption and system temperature. The proposed work is divided into two levels. In the first level the cloud administrator whose main function is to create users different types of load (tasks) and systems with different specifications on which the task will work. After generating of the tasks it is allocated to the system with matching specifications. Each of the tasks will have some requirements like

1. Time to process
2. System demand (CPU, memory)
3. Energy consumption
4. Temperature of Systems

In this work our scheduler algorithm is working in a centralized scheduler schemes i.e collecting all the information about task and dispatching them to the system with appropriate power consumption. Scheduler will generate the jobs (load) and maintains the queue. The scheduler will also check the system specification that dispatches the load to the system. And if the temperature will rise than the critical temperature the system will discard. As a result the scheduler will check the second system with a temperature less than the critical temperature. If the system is below the critical temperature then scheduler checks the power consumption of that system. As well as it will broadcast all the messages to check the power consumption of all the systems and then it will maintain a queue of information of each and every system with less power. In our energy efficient algorithm following specification are:

Critical temperature
Minimum Temperature
Power Consumption

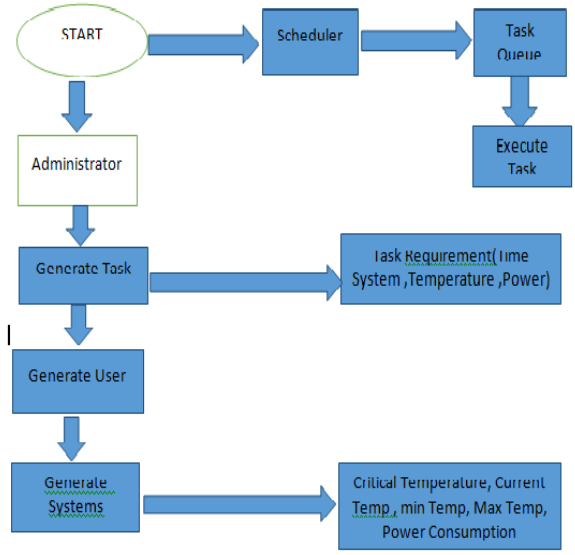

Fig 2.1 Therma l and Power Aware Load balancing

Algorithm Used
System Buffer – Contains all available systems list
S_{temp} Buffer- contains system having less temperature value than threshold temperature.
T_{th}- Threshold value of temperature
T_{sys}- System temperature
P(n)- Power of system n
S[i]- Array containing system withy lowest power increment rate
Del(p) – to calculate the lowest power for S[i].
Algorithm Start
Step 1- while(task scheduling==true)
For each system
If(T_{sys}<T_{th})
Add s[i] to buffer Stemp
End S_{temp} (maintaining systems with less temperature than threshold)

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Step 2- For each System in Stemp queue
Invoke power function Power(Sys(n), P(n))
P_b= Power consuming before allocation of task
P_a= Power consuming after initializing the task
Calculate del(p)=P_a-P_b
For each:- Sort System according del(p) value in array s[] in ascending orser
Allocate task scheduling for those system with having least del(p) value.
If(T_{sys}>=T_{in})
Add system to the buffer
Allocate task to the system from an array[i+1]
End if
Add System to the system buffer.
Step 3-System buffer will maintain discarded Systems.

IV. EXPERIMENTAL SETUP

We have done the experiment in the Cloud simulator where we have implemented the Load balancing Scheduler algorithm in java. Existing Algorithm are in Cloud Simulator like FCFS or Roundrobin which also works in energy efficient concepts. After comparing it with the exisiting algorithms here are the tables of comparison. We have executed the program three times for the evaluation of the average time taken by the Scheduler to maintain the eligible VM queue for load balancing. Here are the results

Phase (temperature-n & power-n)	Average time to schedule
1	8.2 seconds
2	8.4 seconds
3	7.08 econds

Table 1.1 The above table is showing that Average time to schedule is better as compare to FCFS scheduling. Energy temperature consumption graph by applying our scheduling Policy is

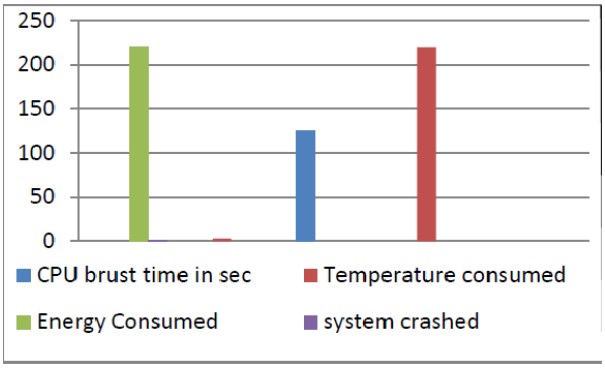

Figure 2.2 Energy temperature consumption graph by applying our scheduling policy

V. CONCLUSION

Energy aware load balancing is an important and demanding research area nowadays. Thermal and power based scheduling policy will help to reduce the cooling cost and it will increase the reliability of the computing resources over Cloud Computing environment. The flow diagram and the algorithm will be helpful in reducing the CO_2 emission. The aim our research is to reduce the temperature of the computing nodes and to distribute the workload in an efficient way considering thermal and power balance of the system.

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