DVFS BASED POWER AWARE SCHEDULING IN CLOUD DATA CENTERS

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Abstract: ***In cloud computing, the energy aware scheduling problem has been a critical issue in high-performance clouds. High energy consumption leads to high CO2 emission. An existing technique Dynamic voltage and Frequency Scaling (DVFS) minimizes energy consumption for data center which will result in the less number of carbon footprints without compromising Quality Of Service (QoS). For the purpose of Green Computing, availability of renewable energy is also checked. The goal of the proposed work is to reduce power consumption while executing tasks. The approach of supplying datacenters with renewable energy reduced number of carbon footprints.***

Keywords - Cloud computing, Dynamic voltage and Frequency Scaling, Energy consumption, Task Urgency

I. INTRODUCTION

Cloud computing is emerging large scale computing which has moved computing and data away from desktop and portable PCs, into large data centers. It provides the scalable IT resources such as applications and services, as well as the infrastructure on which they operate, over the Internet, on pay-per-use basis to adjust the capacity quickly and easily [7]. The National Institute of Standards and Technology (NIST) definition lists five essential characteristics of Cloud computing: on-demand self-service, broad network access, resource pooling, rapid elasticity or expansion, and measured service. In order to obtain more energy reduction as well as maintain the quality of service (QoS) dynamic voltage and frequency scaling (DVFS) is used. DVFS is the adjustment of power and speed settings on a computing device's various processors, controller chips & peripheral devices to optimize resource allotment for tasks and minimize power saving when those resources are not needed. DVFS allows to dynamically adapting the machines performance to the changing condition of workload.
The aim of the proposed work is to reduce energy consumption of cloud Data Center using energy aware Data Center selection algorithm and DVFS technique. Data Center selection algorithm selects Data Center either powered by renewable energy or fuel energy depends on urgency of tasks. DVFS technique is implemented for assigning tasks to virtual machine.

II. RELATED WORK

Nowadays, data centers consume about 2% of the worldwide energy production. Cloud providers need to implement an energy-efficient management of physical resources in order to meet the growing demand for their services[3]. The main strategies for energy-efficiency in Cloud data centers: Dynamic Voltage and Frequency Scaling (DVFS) and Consolidation[3]. DVFS helps to reduce the energy consumption of unutilized resources dynamically, while consolidation strategies decrease energy consumption by reducing the number of active servers. Multimedia applications also consume more power. Multimedia applications associated with higher computing and consume huge amount of power. Many studies explore the opportunities to save power by energy-efficient task scheduling based on the technique of dynamic voltage and frequency scaling (DVFS)[5].

Table 1. Summary of Existing Techniques

Title	Authers	Techniques	Limitations
Improving Energy Efficiency Of Computing Servers And Communication Fabric In Cloud Data Centers[1]	Soma Prathibha, B.Latha and G.Sumathi	Enhanced weighted Dynamic Voltage Frequency Scheduling Algorithm(DVFS)	High fluctuation of available energy during different time periods on a day, month or year.
Dynamic Real-Time Scheduling with Task Migration for Handling Bag-of-Tasks Applications on Clusters[2]	Menglan Hu and Jun Luo.	(SAM) – Scheduling with migration	The scheduling of real-time tasks on clusters is a critical issue for offering quality-of-service (QoS) assurance.
DVFS-Aware Consolidation for Energy-Efficient Clouds[3]	Patricia Arroba, José M. Moya, José L. Ayala & Rajkumar Buyya	1) DVFS policy 2) consolidation	Cloud providers need to implement an energy-efficient management of physical resources in order to meet the growing demand for their services and ensure minimal costs.
Dynamic Voltage and Frequency Scaling based Parallel Scheduling Scheme for Video Recognition on Multicore Systems[4]	Yen-Lin Chen, Ming-Feng Chang, Wen-Yew Liang	DVFS based scheduling scheme	The video recognition on computer systems has high computing complexity and consumed the huge amount of energy.
CloudFreq: Elastic Energy-	Yujian Zhang,	CloudFreq Algorithm	Job rejections caused by

Efficient Bag-of-Tasks Scheduling in DVFS-enabled Clouds[5]	Yun Wang and Cheng Hu		restricted constraints are intolerable to guarantee the service-level agreement (SLA).

III. PROPOSED WORK

Power consumption of the server at load is calculated using following equation,

$P_s(l) = P_{ideal} + \frac{Ppeak - Pidle}{2}(1 + l - e_a^1)$

Where, Pidle = the power consumption at idle load of CPU

Ppeak = power consumption at peak load of CPU

Wi aids the allocation algorithm to decide which server/VM is assigned to which job.

Wi =Pi *Ri[3]

Where, Pi = power of cost of server/VMi

Ri = Resource used by server/Vm

Proposed Algorithm

1. Read the Data Centre, VM
2. Read Task details of workflow
3. For all Ti in T do
4. For all DC in DCList do
5. If DC_renewable_energy is available then
6. Selected _DC= DC_renewable_energy
7. Is Task urgent?
8. If No, Wait for Renewable available and add task to queue
9. Does the job arrival in a time when renewable energy is increasing?
10. The job is short?
11. If yes, postpone by its length t_new= (t_arrival + short_job_length)
12. If not, is the job medium length?
13. Postpone to average time between t_arrival and job's deadline
    t_new=[(t_arrival + (deadline – t_arrival)/2]
14. If not, postpone at its allowed maximum
    t_new= (t_arrival + deadline – 1.2*long_job_length)
15. Does the job arrival in a time when renewable is decreasing?
16. Is the job is short?
17. If not, postpone at its allowed maximum
    t_new=[t_arrival + deadline – 1.1*short_job_length]
18. If not, is the job medium length?
19. Postpone to average time between t_arrival and job's deadline
    t_new=[t_arrival + (deadline –t_arrival)2]
20. If not, then its long job, run immediately, sends to the broker so that it allocates VM as the job requires.
21. endif
22. Selected_DC = DC_fuel_energy
23. End if
24. End of(Task)
25. For all VM in VM[] do
26. VM[i]_fmax = fmax
27. VM[i]_fmin = fmin
28. Wi = Pi * Ri
29. End of(VM)
30. Sort all the VM based on weight Wi value
31. Map the task to the VM with highest Weight value

FLOW CHART

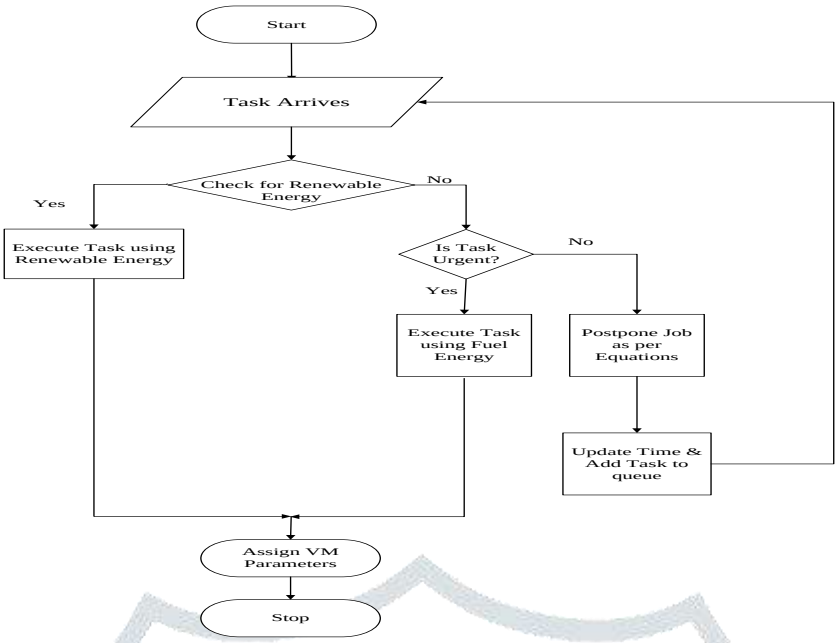

Fig 1. Flowchart

In Algorithm, For the purposed of green computing the Data Center powered by renewable energy is used. The task urgency is checked. After testing the urgency of the arrived job, the algorithm decides to run it if it's urgent or postpone if it's not urgent. If the task is urgent, it will executed by available energy either renewable or fuel energy. But if the task is not urgent then it will wait for renewable energy to available and added to queue. The availability of renewable energy is divided into two sections, testing if the available renewable energy is increasing or decreasing. In each case, the behaviour will be different.

The amount of time it will be postponed depends on renewable energy forecast for next period of time, equal to length of the job. If it's an increasing period, than the job is postponed to the next time period, as long as it satisfies its desired quality of service. Job's deadline is the limiting factor for the postpone process. Otherwise, if it's a decreasing period, the behaviour will be opposite to the previous one described above. Short jobs will be postponed at their maximum, as they require less processing resources, while the long jobs are immediately run in order to use the available renewable energy.

After Data Center Selection, next one is DVFS based task scheduling is explained. The task is assigned to a suitable VM by calculation of weights for each task in cloud data center. This is done by calculation of the weight of each VM. Let Wi = Pi*Ri where Pi is the unit power cost of server/VMi and Ri is resources used by server/VMi. DVFS technique is applied to reduce the energy consumption of the virtual machines. The use of DVFS results in reduced energy consumption as the voltage at which a particular host is varied depends upon the frequency of the given task. Tasks with lower frequency are completed at a lower voltage and vice versa. This leads to overall reduced energy consumption of the servers in Data Center.

IV. RESULTS AND DISCUSSION

The performace analysis of the Data Center selection and Task Scheduling using DVFS technique is carried out using Cloud Analyst. Table 2 shows the details of Data Center configurations. It shows Data Center, UserBase, Regions used in experiment.

Table 2. Details of Data Center Configuration

Number of Data Center	5
Number of User Base	5
Number Of Region	6
Image Size of DC	10000
Memory of DC	512
Bandwidth of DC	1000

Table 3 shows the details of physical hardware of DC in which Memory, Storage, Bandwidth, Number of Processors, Processor speed are given.

Table 3. Details of Physical Hardware in DC

Memory	204800 Mb
Storage	100000000 Mb
Available BW	1000000
Number of Processors	4
Processor Speed	10000

Here, we compare the energy consumption of Data Centers. Data Center powered by renewable energy is reduce the energy consumption of DC as well as reduce the carbon emission. Carbon emission is dengorous to echo system and also for human beings. So, by maximum

utilization of renewable energy we can reduce CO2 emission. Energy consumption is a critical issue in cloud Data Centers. To reduced energy consumption, we also used DVFS technique. DVFS decreases power consumption of servers.

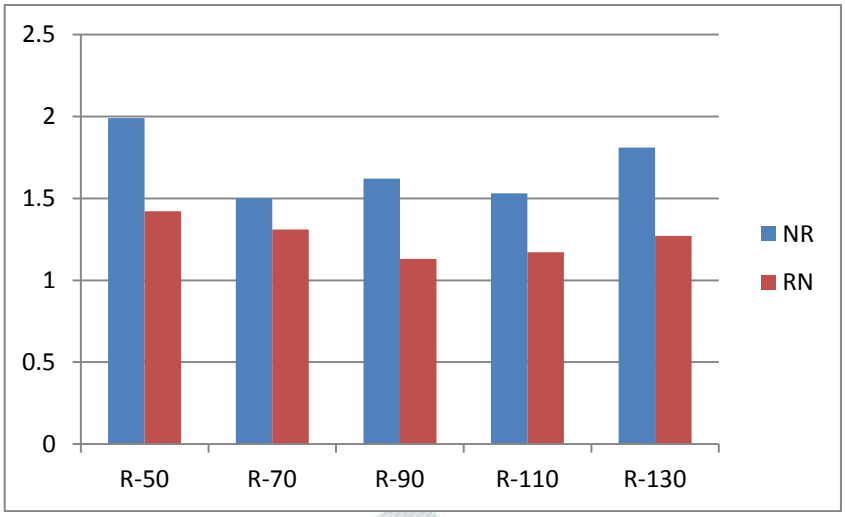

Fig 2. Energy Consumption Of DCs

V. CONCLUSION

Energy consumption is one of the main problems in the cloud computing environment. To solve this problem, we implemented DVFS technique for power aware scheduling problem as well as maximize utilization of renewable energy. And allocate VM to Data Centers. The proposed system checked the task urgency and then select proper Data Center based on source of the Energy either renewable energy or non renewable energy. Then Assign VM to Task by Calculating the Weight of Each Task. This is done by calculating Weight of Each VM. The proposed system provided the better results in reducing the power consumption of the resources and also reducing the CO2 emission by using data center powered by renewable energy.

VI. REFERENCES

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