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Energy Efficient Task Scheduling Mechanism in Cloud Computing

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Abstract : From last few years' Cloud computing has become more and more popular. This increase in popularity of cloud services results in higher resource demands on the provider ends. To fulfill the consumers requirements for cloud hardware, software, platform etc, large number of datacenters is constructed that utilize a huge bulk of datacenters energy and produces carbon dioxide emissions which are very harmful for the environment. Power conservation is one of the major concern in Cloud computing. In this research we are focusing on the concept of task scheduling mechanism in cloud computing. The main objective is to reduce total consumption of energy in datacenters. This research presents a new approach of Energy productive scheduling of tasks to reduce the wastage of power in datacenters so that resources can be properly used. The cloudlets submitted to the cloud provider are executed in an energy efficient DVFS approach.

Keywords : Cloud Computing, DVS, Green Computing, VM, Host.

1. INTRODUCTION

Cloud computing refers to the computing that is based on Internet and contributes a variety of resources, data and applications according to the requirement and demand of consumers. It reduces the burden of IT companies as there is no need to purchase hardware, software and thereby maximizing their profits. Resources of cloud are utilized globally, thus help in reducing the unnecessary wastage of resources and save the cost. Cloud services can be used from anyplace and from any device only through internet connection. Cloud services are metered services *i.e*. consumers are charged according to their usage [1].

Users attracted towards the cloud technology are increasing day by day and their demands for cloud resources are also increasing and to meet the increasing demands of cloud users; there is need to construct large number of datacenters. These datacenters produces huge bulk of heat. As a result, there is increase in the power consumption of IT companies. Nearly 38 GW power was consumed in the year 2012 by datacenters. This power consumption was near about 63% increased than in year 2011 [2]. Likely, for UK families this power would have been sufficient to meet their requirements of energy [3].

If the power consumption is more, bills will also be high. Today, power consumption of datacenters is serious problem as it not only decreases the profit of providers also causes harmful effect on the surroundings. Green Cloud computing is becoming popular to decrease the power consumption, increases the profits of providers and reduces the impact on environment [4]. The main goals of green cloud computing are development of computer systems and applications that have cost-effectiveness and reduced power consumption [5]. One way to achieve green computing is by using Dynamic voltage scaling *i.e*. DVS. DVS helps in reducing the power consumption of datacenters by reducing the voltage supply and frequency.

There are some following research works that have given many ways to solve the problem of power consumption of datacenters and carbon dioxide emissions. Wissam Chedid et.al in [6] explains two techniques for managing power, one is static that is applied at the time of design and second is dynamic that is applied at the run time and

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their main objective is to reduce the power consumed by systems. DVS is used in dynamic technique to save power at CPU level. Abhishek Patial and Sunny Behal in [7] attempts to secure data by using RSA algorithm from unauthorized access. Data security is provided by encrypting the given data based on Key combinations which can only be decrypted by authorized person by making use of his private key. Mohammad A. Haque et.al in [8] proposed a technique in which two processors are used *i.e*. primary and spare. Primary processor execute tasks programmed using EDF at DVS and spare processors execute back up tasks programmed using EDL at CPU full frequency. A.Ejlali et.al in [9] proposed technique in which two processors are used. One is primary and second is spare. Primary processor executes tasks using DVS and spare processor handle back up tasks that will run at CPU full frequency. Abhishek Patial and Sunny Behal in [10] implemented RSA algorithm for data security. To implement RSA algorithm encryption and decryption procedures are used. Sonika P Reddy et.al in [11] presents a system in which there are three processors. For handling real time applications first two processors are used and tasks are scheduled using two algorithms *i.e*. EDF and EDL. Third processor will handle non real time applications that are programmed using first come first serve algorithm. Instruction length of the tasks is not considered before allocating them to a processor.

The rest of the paper is organized as follows. Section II explains proposed approach and algorithm. Section III presents the experimental results. Conclusion is given in section IV.

2. PROPOSED ALGORITHM

The research work is based on the concept of task scheduling mechanism in cloud. The main aim is to reduce the power consumption by datacenters. Energy productive scheduling of tasks helps to reduce the consumption of power in datacenters for the resources to be effectively used. This further reduces cost of operation and helps to increase the benefits of the consumers and service providers. The total power consumption is calculated as:

$$\text{Total power consumption} = P_d * t$$

Where, P_d is the dynamic power dissipation and t is the task execution duration.

Our proposed technique follows the concept of task scheduling in order to reduce the power consumption by datacenters. The tasks are scheduled into three categories *i.e*. High computing tasks, Medium Computing tasks and Low computing tasks based on their Instruction length.

We have taken three processors *i.e*. P1, P2 and P3, respectively. They are arranged in the decreasing order of their processing capabilities. Tasks are scheduled on these three processors. Processor P1 will execute the High computing tasks; Processor P2 will execute the Medium computing tasks and Processor P3 will execute the Low computing tasks.

If we are having a task with high instruction length and is running at DVS then it will consume more time, thereby consuming more power and emitting more CO_2. If we are having a task with lesser instruction length and is running at full frequency then it will consume more power and there will be more CO_2 emission. So we have scheduled the execution of tasks according to the following mechanism:

1. High computing tasks will run at full frequency.
2. Medium computing tasks will run at DVS.
3. Low computing tasks will run at threshold frequency.

40% of full frequency is assumed to be taken as threshold frequency [8] and 15% of full frequency is assumed to be taken as frequency of sleep state [9].

We will implement First Come First serve (FCFS) load balancing algorithm for High Computing tasks, Medium Computing tasks and Low Computing tasks. If any task on Processor P2 and Processor P3 fails, schedule that task on P1 *i.e*. the task will run at full frequency. If no task has been assigned to the processor, then it will enter into the sleeping state to reduce the power consumption.

In this way we can save more power and energy if tasks are scheduled based on their instruction length.

The following figure *i.e*. Fig 1 shows the design of the proposed system.

Energy Efficient Task Scheduling Mechanism in Cloud Computing

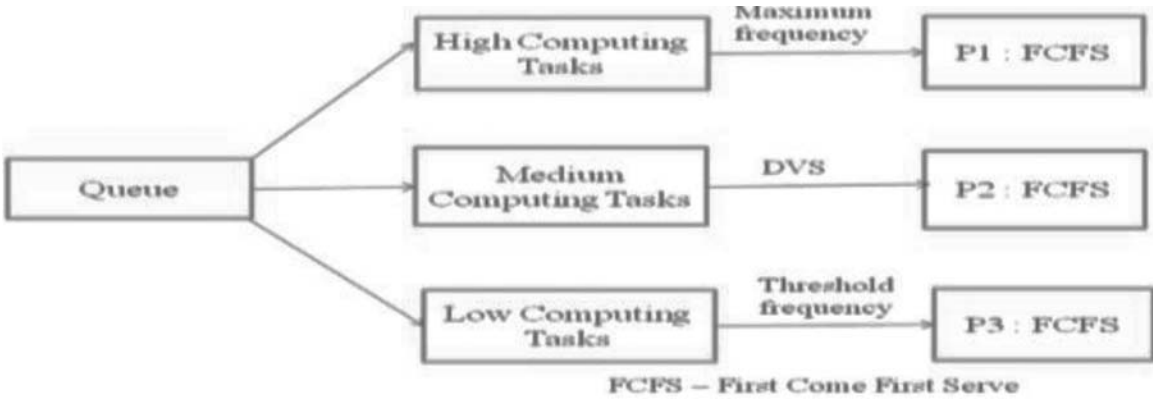
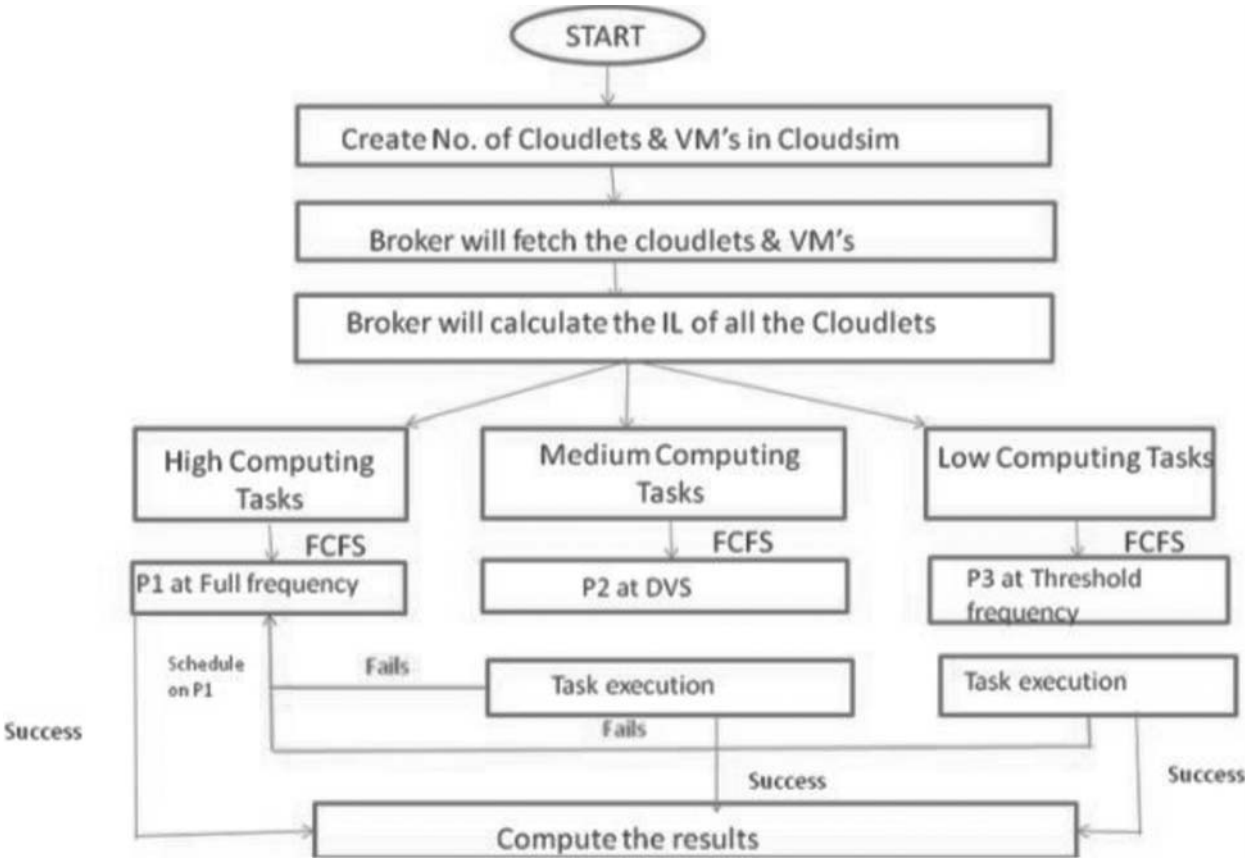


Fig. 1. Design of the Proposed System.

Algorithm :

1. Create n number of cloudlets with different Instruction lengths.
2. Create 3 Virtual machines having different processors.



IL – Instruction Length

Fig. 2. Flowchart of Proposed Algorithm

3. For all cloudlets C_i $i = 1$ to n.
   Compute Instruction length of each task. Divide the C_i into low, medium and high zone. End;
4. For all Cloudlets in high zone
   Assign C_i to P1 processor that will be running at full frequency and First Come First Serve (FCFS) algorithm will be implemented.
   End;

5. For all Cloudlets in medium zone

   Assign C*i* to P2 processor that will be running at DVS and First Come First Serve (FCFS) algorithm will be implemented.

   End;

6. For all Cloudlets in low zone

   Assign C*i* to P_3 processor that will be running at threshold frequency and First Come First Serve (FCFS) algorithm will be implemented.

   End;

7. If any task on P_2 and P_3 fails, Schedule that task on P_1 *i.e*. the task will run at full frequency.

   End;

3. EXPERIMENT AND RESULT

We have used the CloudSim as a simulator for implementing the proposed methodology and the graphs shown below were obtained *i.e*. From Fig. 3 to Fig. 5.

It is clear from the Figure 3, that the power consumption in the proposed work is very less as compared to the power consumed in the existing work. The values of different parameters like processing time, processing cost, power consumed by the different number of cloudlets have been calculated. In the below bar chart, by comparing the energy efficiency, there is 17.1% reduction in power consumption. The user applications are based on the size of instruction (number of MIPS) of the applications.

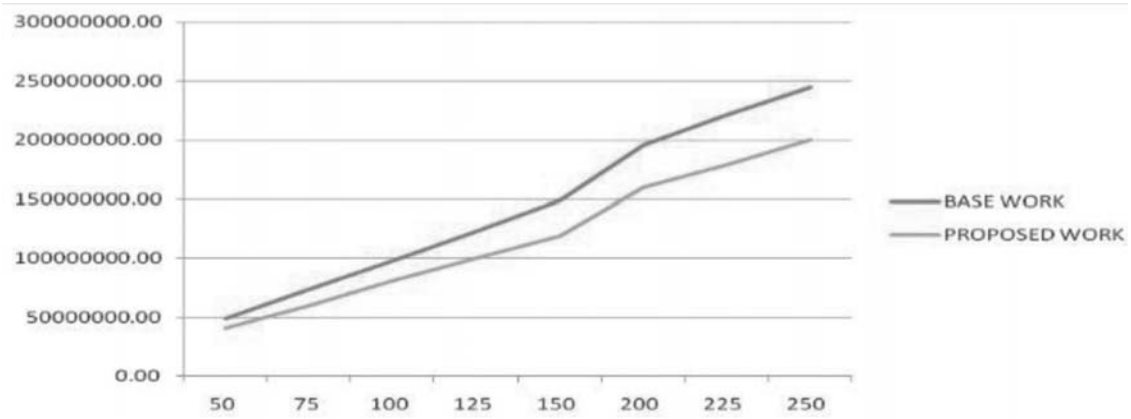


Fig. 3. Total Power Consumption Graph

The Figure 4 shows that the total processing time of cloudlets in proposed work is less when it is compared with total processing time of cloudlets in base work.

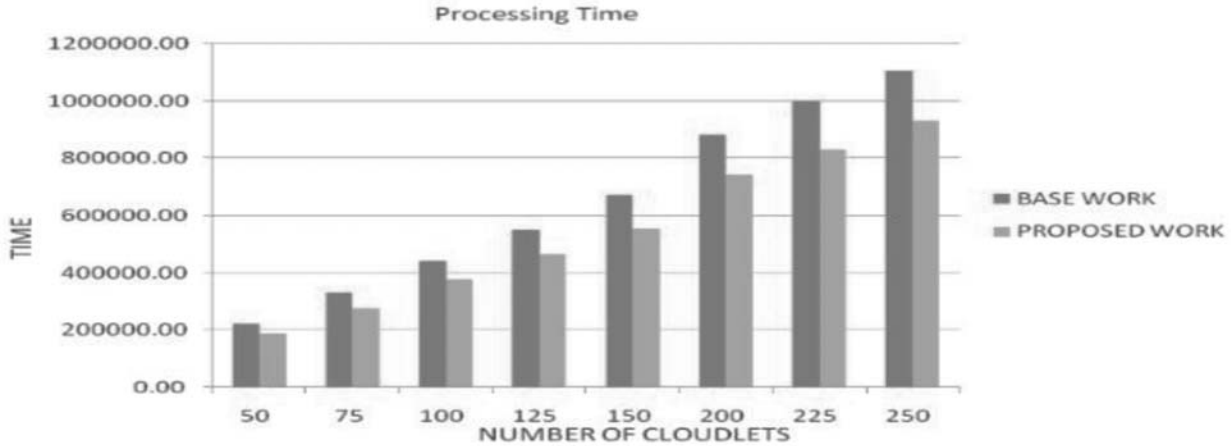


Fig. 4. Total Processing Time

Figure 5 shows that the total processing cost of proposed work is less as compared to the total processing cost of base work. Reduction in cost provides benefits to the consumer and service provider.

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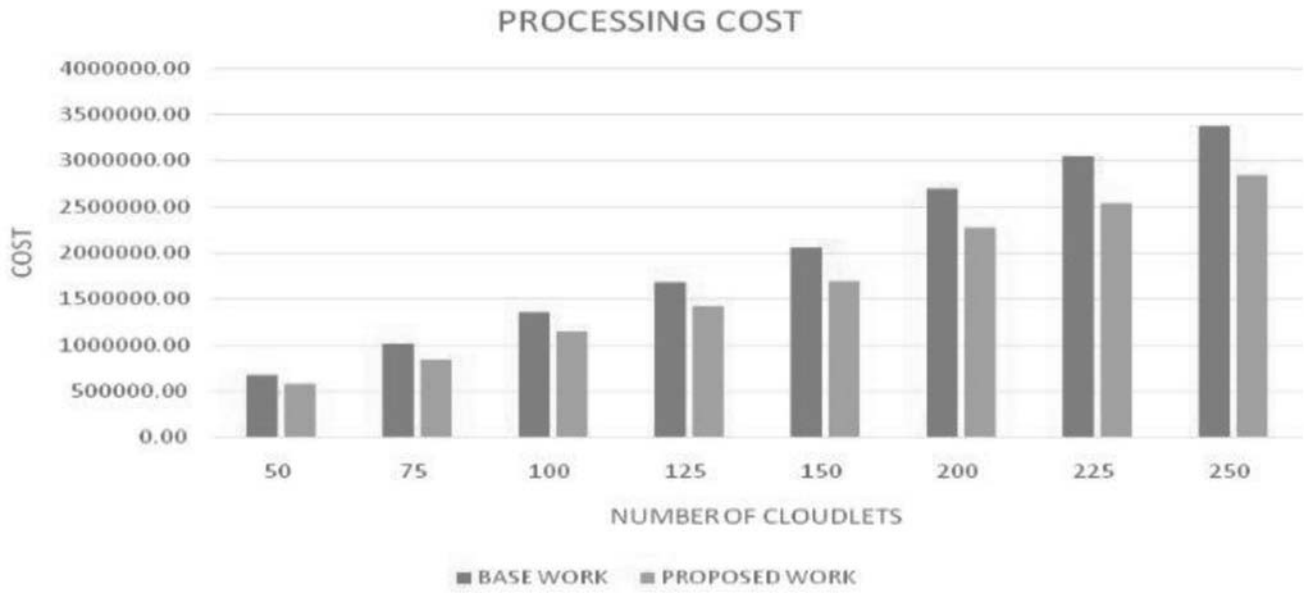

Fig. 5. Total Processing Cost

4. CONCLUSION

This paper gives the introduction of Cloud computing and background of various workload consolidation techniques to manage heterogeneous workloads. It also considers various existing load balancing scheduling algorithms. As the energy efficiency is one of major problem in cloud computing. So, in this work efficient energy consumption technique has been proposed. Many load balancing algorithms are existing today but no is one energy efficient as they balance the load among the nodes of virtual machines. The proposed technique can balance the load as well as it is energy efficient.

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