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A NOVEL APPROACH OF TASK CLASSIFICATION AND VM SKEWNESS IN CLOUD ENVIRONMENT

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ABSTRACT

Cloud Computing is a technology that provides a platform for sharing of resources such as software, infrastructure, application and other information. Cloud Computing is being used widely all over the world, as it provides benefits to the users like cost saving and ease of use. The research work focuses on the study of task scheduling mechanism in cloud. The main goal is to reduce the power consumption by datacenters. Energy efficient scheduling of workload help to reduce the consumption of energy in datacenters thus helps in better usage of resources. An improved power saving algorithm is proposed by combining the task classification along with VM skewness algorithm with different scaling options. Skewness is used to quantify the unevenness in utilization of multiple resources on the server. Our purposed algorithm calculate the skewness factor of all Virtual Machines and based upon its value. The proposed approach is performing and shows a decrease in response time, waiting time, processing cost and overall electrical power consumed. The study can be further extended by applying the proposed algorithm on actual Cloud Computing environment and we can also integrate various energy saving technologies into data centers to reduce energy consumption.

Keywords

Cloud Computing, SLA, Green Computing, Power Saving, skewness.

INTRODUCTION

Cloud computing is a computing paradigm, where a large pool of systems are connected in private or public networks, to provide dynamically scalable infrastructure for application, data and file storage. With the advent of this technology, the cost of computation, application hosting, content storage and delivery is reduced significantly [5]. Cloud computing is a practical approach to experience direct cost benefits and it has the potential to transform a data center from a capital-intensive set up to a variable priced environment. The idea of cloud computing is based on a very fundamental principal of „reusability of IT capabilities'. The difference that cloud computing brings compared to traditional concepts of "grid computing", "distributed computing", "utility computing", or "autonomic computing" is to broaden horizons across organizational boundaries. [3] Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction .Cloud computing has emerged as a popular solution to provide cheap and easy access to externalized IT (Information Technology) resources. An increasing number of organizations (e.g., research centers, enterprises) benefit from Cloud computing to host their applications.

POWER CONSUMPTION IN CLOUD COMPUTING

Power consumption is the key concern in content distribution system and most distributed systems (Cloud systems). These demand an accumulation of networked computing resources from one or multiple providers on datacenters extending over the world. This consumption is censorious design parameter in modern datacenter and cloud computing systems. [11] The power and energy consumed by the computer equipment and the connected cooling system is a major constituent of these energy cost and high carbon emission. Modern data centers, operating under the Cloud computing model, are hosting a various applications ranging from those that run for a few seconds (e.g. serving requests of web applications such as e-commerce and social networks portals) to those that run for longer periods of time (e.g. simulations or large dataset processing). Cloud Data Centers consume excessive amount of energy. It is accountable for global increase in energy consumption, and energy cost additionally as a proportion of IT costs. Now days the incipient software which are being used are devouring more and more power per year. Some of them require virtually steady access to the hard drive which drains power more rapidly than precedent software did. Power and energy consumption are key concerns for data centers. These centers abode thousands of server and support infrastructures for cooling as well. [11]Researchers have now made resultant tread in making their effort to conserve energy in servers because they have been given these benefits, by calculating the greatest power utilizing HP's power calculator the power consumption for each server can be found. Then we can follow the convention which average power usage either for midrange or for high-end servers which is around 66% of the utmost potency. Hard disk arrays comprise fortifying the functions like cache recollections, disk array controllers, disk enclosures and redundant power supplies. When we verbalize about cloud computing data centers the storage spaces which have in the data center is consolidated and hard disk utilization is centrally harmonized. Multiple number of users can share a single server through server virtualization, which ultimately increases resource utilization and in turn reduces the total number of server's desideratum. Users do not need to aware the operations being performed by other users and can facilely utilize the server cerebrating themselves to be the only utilize on that server. Where in some servers enter into a sleep mode, when they are not in demand, which ultimately reduces energy consumption [11].

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ESSENTIAL STEPS TO REDUCE THE POWER CONSUMPTION

- Shut down the CPU and other devices during inactivity.
- Use power-up and power down devices to switch off the devices when not in use.
- Do computer related tasks continuously so the in the remaining time it is possible to switch off peripherals to save energy.
- Try to use liquid-crystal-display (LCD) monitors rather than cathode-ray-tube (CRT) monitors.
- Try to use notebook rather than desktop whenever possible because a desktop requires more energy than a notebook.

RELATED WORK

Yi-Ju Chiang et al. (2014) discussed that cloud computing is a new service model for sharing a pool of computing resources that can be rapidly accessed and released based on a converged infrastructure. In the past, an individual use or company can only use their own servers to manage application programs or store data. Thus it may cause the dilemma of complex management and burden in “own-and-use” patterns. Lucio et al. (2014) presents a hybrid optimization model that allows a cloud service provider to establish virtual machine (VM) placement strategies for its data centers in such a way that energy efficiency and network quality of service are jointly optimized. Usually, VM placement is an activity not fully integrated with network operations. As such, the VM placement strategy does not take into account the impact it produces on the network performance in terms of quality of service parameters such as packet losses and traffic delays. The proposed strategy allows cloud providers to reach a balance between the energy efficiency of their infrastructures and the network quality of service they offer to their customers [16].Bharti Wadhwa et al. (2014) uses the carbon footprint rate of the datacenters in distributed cloud architecture and the concept of virtual machine allocation and migration for reducing the carbon emission and energy consumption in the federated cloud system. The proposed approach reduces the carbon dioxide emission and energy consumption of federated cloud datacenters as compared to the classical scheduling approach of round robin VM scheduling in federated cloud datacenters [4].Sonika P Reddy et al. (2014) presented a system that handles real-time and non-real-time tasks in an energy efficient method without compromising much on neither reliability nor performance. Of the three processors, two processors i.e. the first and second, handle real-time tasks, using earliest-Deadline-First (EDF) and Earliest-Deadline-Late (EDL) scheduling algorithms respectively. On the third processor, the non-real-time tasks are scheduled using the First Come First Served (FCFS) scheduling algorithm and the tasks are run at an energy efficient frequency. Their simulation results show significant energy savings compared to the existing Stand-by Sparing for Periodic Tasks (SSPT) for a few execution scenarios [31].Samiran Roy et al. (2014) states that the computing is a computational framework that provides collection of virtualized resources as Service. Cloud computing is highly profitable cost effective services in the business world in the present day scenario. However, the energy consumption of Data Centers is the big problem emerging out of growing demand for cloud services. That type of critical issues not only reduces the profit margin, but also has effect on high carbon production which is a harmful for environment and living organisms. On the other hand, Green Computing is an overwhelming need based environment friendly computational framework empowered by low emission rate. The basic principles of Green computing is directed towards environment friendly computation [32].Eduard Oro et al. (2014) discusses the continuous growth in size, complexity and energy density of data centers due to the increasing demand for storage, networking and computation has become a worldwide energetic problem. Therefore ,the implementation of well-known and advanced energy efficiency measures to reduce data centres energy demand play an important role not only to a supportable growth but also to reduce its operational costs. This research work presents a comprehensible overview of the current data centre infrastructure and summarizes a number of currently available energy efficiency strategies and renewable energy integration into datacenters and its characterization using numerical models [8].Fahimeh Farahnakian et al. (2015) investigated the effectiveness of VM and host resource utilization predictions in the VM consolidation task using real workload traces. The proposed approach provides substantial improvement over other heuristic algorithms in reducing energy consumption, number of VM migrations and number of SLA violations. Dynamic Virtual Machine (VM) consolidation is one of the most promising solutions to reduce energy consumption and improve resource utilization in data centers. Since VM consolidation problem is strictly NP-hard, many heuristic algorithms have been proposed to tackle the problem [9].

PROBLEM STATEMENT

The number of online services—such as search, social networks, online gaming and video streaming— has exploded. This has led to the construction of large-scale computing data centers consuming enormous amounts of electrical power. Despite of the improvements in energy efficiency of the hardware, overall energy consumption continues to grow due to increasing requirements for computing resources. So, we investigate heterogeneous workloads of various types of Cloud applications and develop algorithms for energy-efficient mixing and mapping of VMs to suitable Cloud resources in addition to dynamic consolidation of VM resource partitions. So, the aim of the research work is to consolidate the load balancing with optimized energy conservation in an efficient way so that the resource utilization can be maximized and the energy consumption of the data center could be minimized that can further result in reducing global warming and hence assist in achieving Green Computing.

• High priority jobs will add more burden to the virtual machine if the virtual machine is already running at the threshold value. Hence, consuming more amount of energy.

• Waiting time of the cloudlets whether they are of high priority or low priority is more in the current scenario.

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RESEARCH OBJECTIVES

In cloud computing, load balancing is necessary to distribute the dynamic local workload across all the nodes. It helps to achieve reliability which depends on the way it handles the load by ensuring an efficient and fair allocation of every computing resource. Cloud load balancing helps to improve the overall cloud performance by minimizing resource consumption and avoids bottlenecks.

• To implement and study the performance of existing energy and power saving algorithm.

•To investigate heterogeneous workloads of various types of Cloud applications and develop algorithm for energy-efficient mapping of VMs to suitable cloudlets.

•To design the improved power saving algorithm by combining the task classification along with VM skewness algorithm with different scaling options.

•To reduce the overall energy consumption and overall cost of the client as well as the cloud provider.

•To develop the proposed algorithm and compare the performance of proposed algorithm with existing algorithm.

SKEWNESS ALGORITHM

Skewness algorithm measure unevenness by combine different type of load and improves resource utilization of server. The concept of skewness is introduced to compute the unevenness in the utilization of multiple resources on a server. It is favorable if a physical machine runs many memory-intensive VMs with low CPU load and due to which lot of CPU resources will be wasted because we have limited memory for an extra VM. By minimizing the skewness, we can combined the different workloads can be nicely and improve the overall utilization of servers. The “skewness” concept is used to measure the un-evenness in the multiple resource utilization of a server and avoid overload by adding different workloads and optimize utilization of server resources. To minimize skewness here combine different types of loads. Skewness can be measured by Hot and Cold spot.

• Hot spot: If consumption of any resources is over a hot threshold. It specifies that the server is overloaded and some VMs running on it might be migrated.

• Cold spot: If consumption of resources is under a cold threshold. It specifies that the server is usually idle and it should be turn off to save energy.

• Overload avoidance: The potential of a PM should be enough to fulfill all VMs the resource required and it should use resource below high limit to avoid overload.

• Green computing: The number of PMs in used should be decrease as they meet the requirement of all VMs. PMs that not in used can be turned off to save energy.

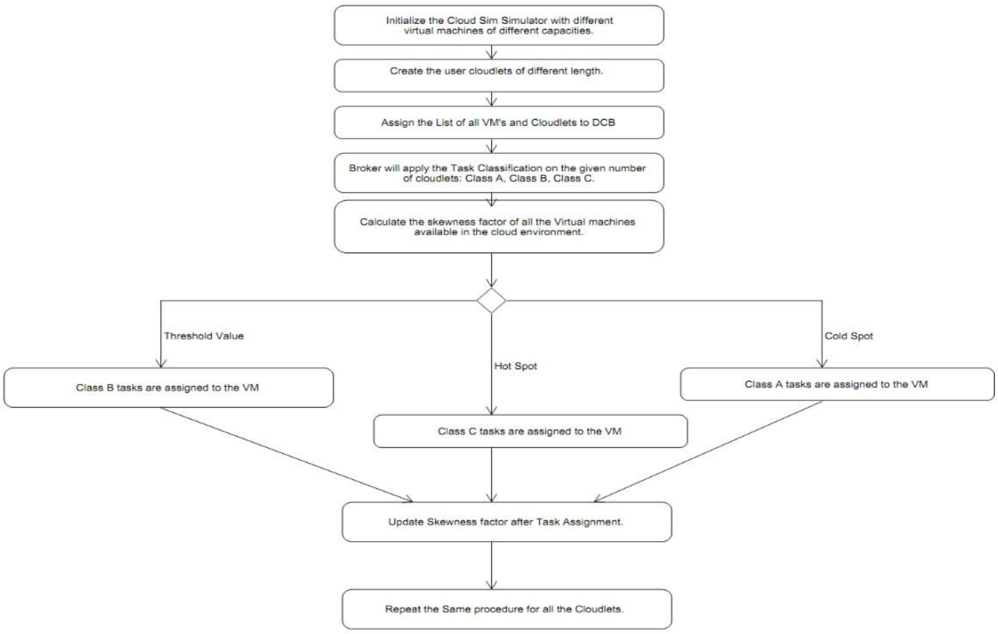

Figure 1. Flow Chart of Proposed Methodology

RESEARCH METHODOLOGY

• Initialize the cloud sim simulator in Java with different number of hosts and virtual machines of different capacities.
•Virtual machines are created inside different hosts within multiple data centers.

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•Create the different number of cloudlets of varying length or size in the cloud environment.
•The list containing the multiple virtual machines and cloudlets will be given to the data center broker (DCB).
•The broker will fetch all the cloudlets and will perform the task classification
•All the tasks given by the user are fetched and are divided into 3 classes depending upon their types.
•Class A: This class contains all those cloudlets that require very high computing resources. Eg: Scientific calculations / multimedia applications etc.
•Class B: This class contains all those cloudlets that require very normal computing resources. Eg: Development / Testing applications etc.
•Class C: The applications / tasks that require very minimum computing resources are covered inside this class. Eg: Document Processing (MS-Word) etc.

SIMULATION RESULTS

The Proposed work Power Savings in Green Cloud environment using task classification and VM skewness will work in heterogeneous environments. In the following tables, we have taken multiple cloudlets and compare with base work and proposed work. To compare the results of proposed work we are taking 10 virtual machines with MIPS = 30, RAM= 70 MB and Bandwidth = 300 Mbps to calculate processing time waiting time and power consumed.

- **TOTAL PROCESSING TIME**

It is defined as the time interval between the request sent and response received by the cloud user/consumer. Overall processing time is calculated as given as follow:-

Response Time (RT) = FT-ST

Where, FT = Finish time of execution

ST= Start time of execution

Table 1. Processing time in seconds comparison

No. of Cloudlets	Existing work	Present work
1000	1	1
2000	3	2
3000	4	3
5000	7	6
7000	10	8
8000	12	9
9000	13	10

The data, thus collected is used to plot a graph consisting of number of jobs and the processing time of the existing work and the present work.

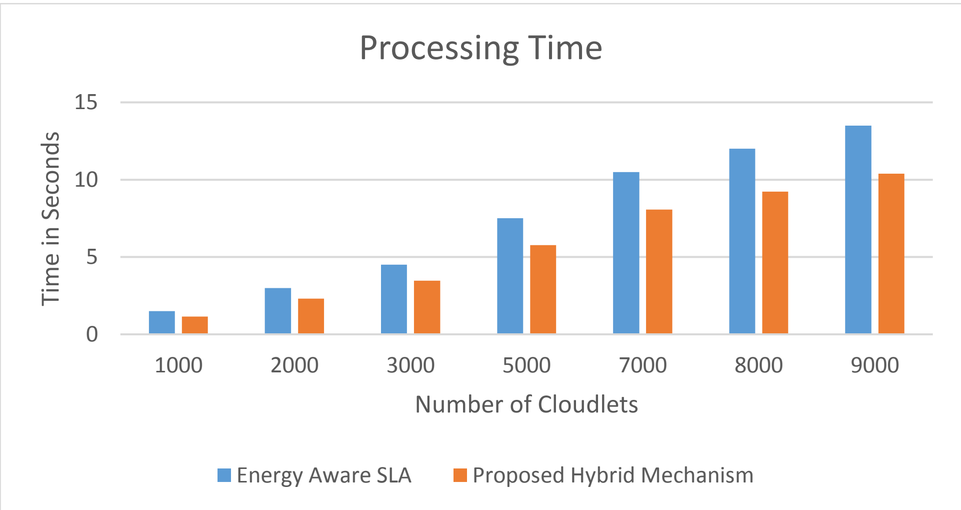

Figure 2. Total Processing Time

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From the above bar chart, it is clear that the total processing time has been reduced.

- **TOTAL WAITING TIME**

Waiting Time = Allocation Time – Generation Time

Table 2. Energy Aware SLA and Present Total Waiting Time

No of Cloudlets	Existing work	Present Work
1000	74	70
2000	298	279
3000	672	630
5000	1871	1751
7000	3669	3433
8000	4793	4485
9000	6067	5677

The bar chart presented in figure 3 shows that the total waiting time has been reduced. We have succeeded in reducing the waiting time of the cloudlets that will encourage the users to use our cloud services.

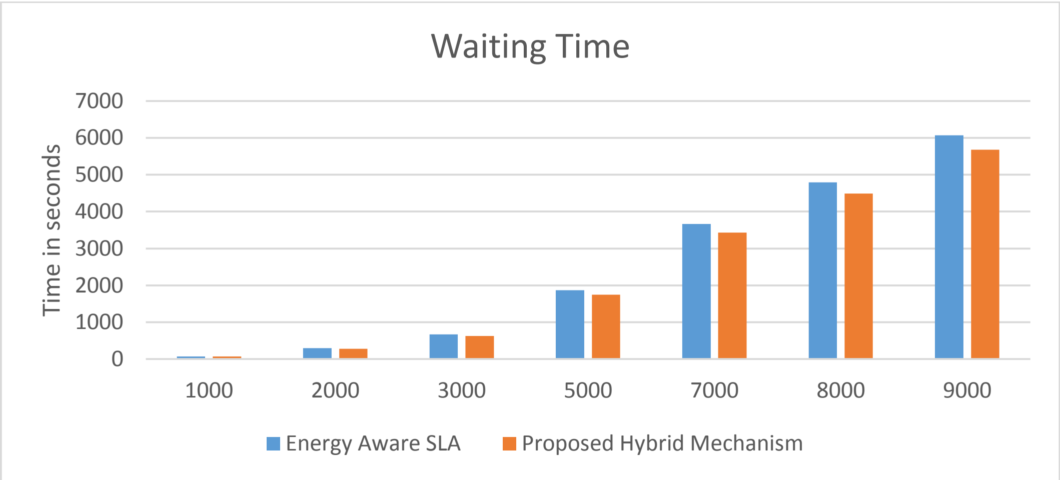

Figure 3. Total Waiting Time

- **TOTAL POWER CONSUMED**

Total Power Consumed = Total Processing Time * Power of Virtual Machine

Table 3. Base vs. Proposed Total Power Consumed

No of Cloudlets	Total Power Consumed (Watt-Sec)	Total Power Consumed (Watt-Sec)
1000	333	256
2000	666	512
3000	999	768
5000	1665	1281
7000	2331	1793
8000	2664	2049
9000	2997	2305

The advantage of reducing power consumption is less heat is generated by device which benefits the mechanical design as well as it improves the lifetime period of devices. In addition, low power consumption by the infrastructure leads to drop in carbon dioxide (CO_2) emissions contributing to the concept of green cloud computing.

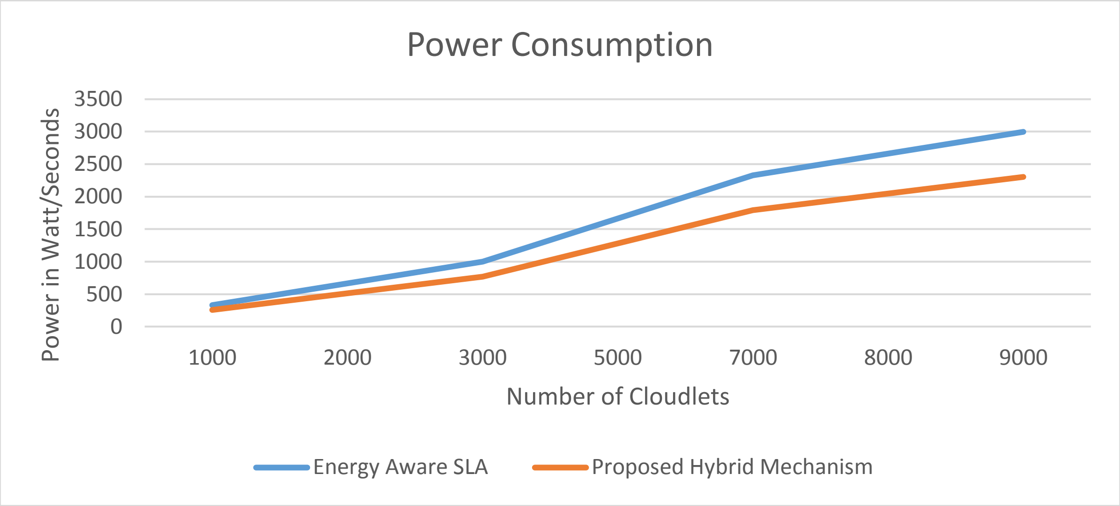

Figure 4. Total Power Consumed

From the above bar chart, it is clear that the total power consumption has been reduced. Global warming has been a hot topic for years, but that's no reason for us to get cold feet when considering going cloud.

- **PROCESSING COST**

Processing Cost = Processing time * Rate per unit

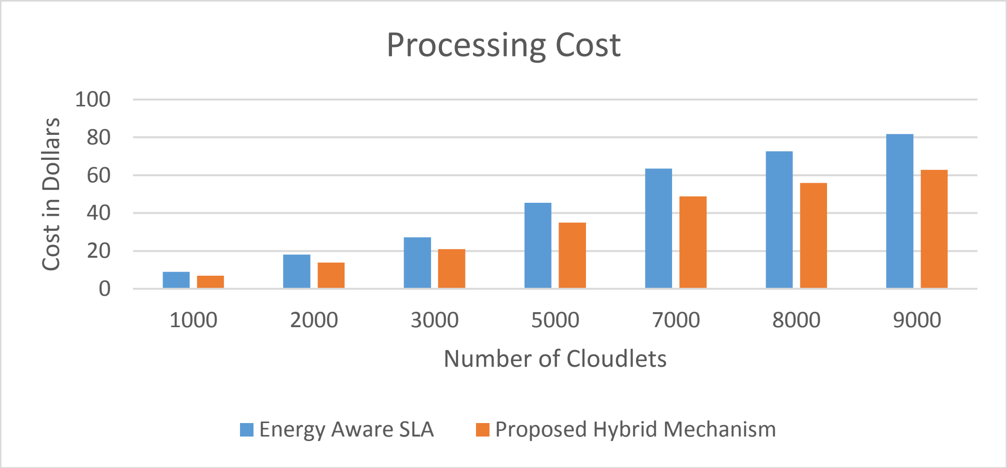

Figure 5. Processing Cost

From the experimental results it is clear that we have been able to reduce the processing time, waiting time, processing cost and power consumption for different number of cloudlets.

CONCLUSION

The proposed technique shows approximately 23% reduction in power consumption, 6% reduction in total waiting time and 23 % reduction in total processing time .The benefit of reducing power consumption is less heat is generated by device which benefits the mechanical design as well as it improves the lifetime period of devices . In addition , low power consumption by the infrastructure leads to drop in carbon dioxide (CO2) emissions contributing to the concept of green cloud computing. This work shows the energy consumption of the heterogeneous workloads. Other processing element like number of CPU's required by a cloudlet can also be considered to further increase the efficiency of workload consolidation technique. To achieve Green Cloud Computing server data centers can use renewable energy sources like the solar system, bio-gas plant energy, wind energy can provide power to data centers as these are eco-friendly sources of energy. To achieve more realistic results, the experiments can be conducted on Open Stack etc.

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