ENERGY CONSUMPTION IN SLA VIOLATION OF ST POLICY

Mohammad Ilyas Malik[1], Er Jyoti Arora[2]
[1]Department of computer Science and Engineering, Desh Bhagat University, Punjab, India.
[2]Assistant professor, Department of computer Science and Engineering, Desh Bhagat University, Punjab, India
Ilyasmalik.418@gmail.com

Abstract—Cloud computing offering utility-oriented IT services to worldwide users. In light of a compensation as-you-go model, it enables hosting of unavoidable applications from scientific, customer and business domains However, data centers hosting Cloud applications consume very large amounts of energy, adding to high operational expenses and carbon footprints to the environment. Therefore, Green Cloud computing give a solution that can save energy for the environment as well as reduce operational costs. This work presents architectural components for energy-efficient management of Cloud computing environments, Energy consumption in SLA violation of ST policy and scheduling algorithm. We focus on the advancement of dynamic resource provisioning and allocation algorithms that consider the cooperative energy between different server farm foundations (i.e., the hardware, cooling, power units, and software), and comprehensively work to boost data center energy effectiveness and performance. In particular, this work proposes (a) Define architectural components for energy-efficient management for Cloud computing. (b) To implement ST policy for minimizing energy in the Cloud infrastructure. (c) To implement resource allocation mechanisms and policies for data centers that improves the energy efficiency of the data center, without violating the negotiated Service Level Agreements (SLA). (d) To analyze the energy efficiency in relation to carbon footprint. We have approved our methodology by conducting a lot of rigorous performance evaluation study utilizing the CloudSim toolkit. The outcomes exhibit that Cloud computing model has immense potential as it offers critical execution gains as respects to response time and cost saving under powerful dynamic workload situations.

Keywords— Cloud Computing, Green Computing, In Architecture of a green cloud computing platform, Scheduling process in cloud, Resource allocation or virtual machine migration techniques, Genetic algorithm, ST policy, DVFS Techniques.

I. INTRODUCTION

With the discovery of IoT, the evolution in the direction of communication networks and ubiquitous information is growing. IoT devices generate massive data at every minute that can be described in volume, variety and velocity [1]. This heterogeneous and huge data need to be presented, managed and stored in a unified, efficient, easily interpretable form and in correct amount of time for different services [2]. Numerous services require quick response time from the servers like health services, video streaming, vehicular networks, industrial urgent data etc. Cloud servers reside at the core of network, but such services can suffer from round trip latency (from device to server and vice-versa) which is quite unacceptable. A very large number of devices connected to cloud servers produce the varieties of data in large volumes, thus increase the work load on cloud. The cloud computing has various short comings like high latency time, cost, jitter, unawareness, limited support for mobility, high network bandwidth requirements. These shortcomings need to be fulfilled with efficient amount of time and cost. Thus, introducing green computing, which provides the effective solution for fulfilling the shortcomings of the cloud computing. As green computing retains the data and computational devices close to the end users thus decreases the energy consumption and cost significantly. The major challenge for green computing is resource management of virtualization of servers, power, data centers design, eco-labeling, recycling methods, environment sustainability design and energy efficient resources etc. The proposed work focuses on resource provisioning and consumption of energy because of heterogeneity of resources.

A . CLOUD COMPUTING

Cloud computing is utilized by IT Services companies for the conveyance of computing requirements as a service to a heterogeneous network of end-recipients. The computing utilities vision is dependent on a service provisioning model foreseen the enormous change of the whole computing industry in the 21st century whereby computing services will be promptly accessible on demand, as other utility services accessible in the present society. Thus, clients need to pay providers just when they get to the accessing computing services. Moreover, consumers never again need to invest heavily or encounter difficulties in building and maintaining up complex IT infrastructure.

In such a model, clients access services dependent on their requirements without regard to where the services are facilitated. This model has been referred to as utility computing, or as Cloud computing. The latter term indicates the "infrastructure as a Cloud" through which organizations and clients can access applications as services from anyplace in the world on demand. Henceforth, Cloud computing can be classified as a new paradigm for the dynamic provisioning of computing services upheld by state-of-the-art data centers that generally utilize Virtual Machine (VM) advancements for consolidation and environment isolation purposes.

Cloud computing delivers platform, infrastructure, and software as services, which are accessible to consumers as membership-based services under the pay-as-you-go model. In industry these services are referred to as

- PaaS (Platform as a Service),
- IaaS (Infrastructure as a Service), and
- SaaS (Software as a Service).

Clouds mean to drive the structure of the cutting-edge server farms by architecting them as systems of virtual services (database, hardware, user-interface, application logic) so that users can access and deploy applications from anyplace on the world on demand at competitive expenses depending upon their QoS (Quality of Service) requirements [3].

Clouds are virtualized datacenters and applications offered as services on a membership premise. They require high energy utilization for its activity. Today, an ordinary datacenter with 1000 racks require 10 Megawatt of capacity to work. so, that the operational costs is high. Therefore, for a datacenter, the energy cost is a significant component of its working and up-front expense. As indicated by a report published by the European Union, a decrease in emission volume of 15%–30% is required before year 2020 to keep the worldwide temperature increment underneath 2 C. Therefore, energy utilization and carbon emission by Cloud infrastructures has turned into a key environmental concern [4].

B. GREEN COMPUTING

Green IT, it is the eco-friendly utilization of PCs and related resources. such type of practices includes the usage of energy-efficient servers, central processing units, peripherals just as decreased resource utilization and proper transfer of electronic waste. Green computing is a study and practice with regards to designing, using, manufacturing, and disposing of servers, computers, and related subsystems-or example storage devices, monitors, printers, and communications and networking systems-efficiently and successfully with insignificant or no effect on the environment.

The idea of green computing is similar to green science; reduce the utilization of hazardous materials, advance the biodegradability or recyclability of defunct items and factory waste and advance the biodegradability or recyclability of defunct items and factory waste, and expand energy effectiveness during the items lifetime. Research continues into key areas, for example, utilizing computers as energy effective as could reasonably be expected, and designing algorithms and systems for effectiveness related computer technologies.

There are a few ways to deal with green computing specifically

- Power management
- Virtualization
- Resource allocation
- Algorithmic efficiency

Green Cloud computing can be used to achieve efficient processing and use of computing infrastructure and minimize energy consumption. It is needed for guaranteeing that the future development of Cloud computing is sustainable else, cloud computing with expanding front-end client devices interacting with back-end server farms will cause very large escalation of energy utilization [5].

II. LITERATURE REVIEW

Fei Cao et al. (2013) presented in this paper [6], an energy-efficient work process scheduling dependent on DAG (Directed Acyclic Graph) model. In this paper, DVFS technique is adapted for resource arrangement and allocation of cloud data centers. In addition, authors have examined few areas like resource utilization, high performance, VM overheads, energy consumption and CO2 emissions. However, all approaches work efficiently but compromise on SLA regulations. However, all approaches work efficiently but compromise on SLA regulations. DVFS method heavily relies on the hardware and isn't controllable according to the varying needs.

Vahora & Patel (2015) presented in this paper [7], analyzed the impact of VM size and network bandwidth on VM migration time and energy consumption of the source system. Variation in VM size and system data transfer capacity results a huge effect on energy consumption of source system during VM Live migration. Further we can reduce energy consumption and migration time of subsystems by choosing VM with least memory size for migration and expanded system data transfer capacity. Consequences of this investigation would help to design algorithm to enhance energy requirements in live migration of VMs. Live migration feature of Virtualization can possibly streamline energy effectiveness during live migration.

Cloud infrastructure Current state-of-the-art such as Amazon EC2 [8] neither help energy-effective resource allocation that considers consumer inclination for energy saving plans, nor utilize sophisticated economic models to set the right incentives for consumers to reveal information about their service demand accurately. Henceforth, providers are not able to foster basic information exchange with consumers and subsequently cannot attain efficient service allocation, which meets consumer needs and expectations with regards to their energy saving preference for Green Cloud computing.

Xu et al. (2010) introduced in this paper [9], virtual machine consolidation a multi target optimization issue while minimizing SLA violation and energy utilization in the same time and an improved in genetic algorithm with fuzzy multi-target computation for VM consolidation.

Atiewi et al. (2016) exhibited in this paper [10], an enhancement model for task scheduling. It is used to minimize energy consumption using integer programming. Furthermore, Greedy Task Scheduling Algorithm (GTSA) is utilized to reduce normal response time and total number of dynamic servers needed to execute a task. So as to makes effective use of data centers, Most Efficient Server First Task Scheduling (MESF) algorithm is utilized to find energy usage cost. Finally, the outcome demonstrates that 70% energy is saved. In the interim, authors basically focus on response time reduction however not on server load balance and system performance.

.

III. METHOLODOLOGY

Three methodologies have been gone out to make cloud computing environments increasingly natural amicable.

A. Architecture of a green cloud computing platform

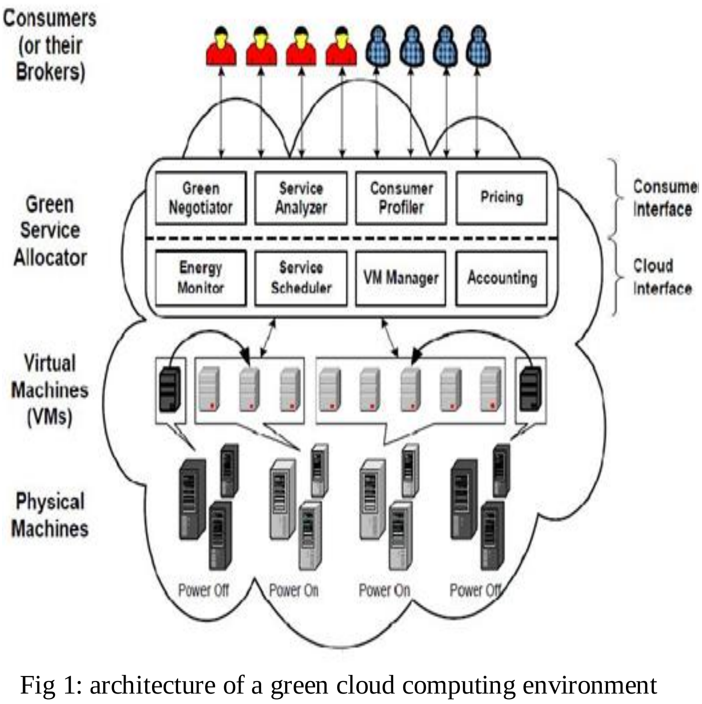

Fig 1: architecture of a green cloud computing environment

Figure 1 shows the high-level architecture for supporting energy-efficient service allocation in Green Cloud computing framework [11]. There are basically four main entities involved:

a) Consumers: Cloud consumers submit service demands from anyplace in the world to the Cloud. It is imperative to notice that there can be a difference between Cloud consumers and clients of deployed services. For example, a customer can be an organization deploying a Web application, which presents varying workload at hand as indicated by the number of clients to getting it.

b) Green Resource Allocator: it acts as the interaction between the Cloud framework and purchasers. It requires the connection of the accompanying parts to help energy-effective resource management.

Green Negotiator: it negotiates with the purchasers/brokers to conclude the SLA with determined costs and punishments (for violations of SLA) between the Cloud supplier and consumer relying on the consumer's QoS prerequisites and energy saving plans. In the event of Web based applications, for example, QoS metric can be 95% of requests being served in less than 3 seconds.

Service Analyzer: Interprets and examinations the service necessities of a submitted request before choosing whether to accept or reject it. Thus, it needs the most recent load and energy data from Virtual Machine Manager and Monitor Energy individually.

Consumer Profiler: It gathers distinct characteristics of consumers so significant consumers can be allowed exceptional privileges and prioritized over different consumers.

Pricing: It chooses how service requests are charged to deal with the activity of market supply and demand of computing resources and encourage in organizing service allocations effectively.

Energy Monitor: It Observes and figures out which physical machines to power on/off.

Service Scheduler: It send requests to virtual machines and decides resource privileges for allocated VMs. It additionally chooses when VMs are to be added or evacuated to meet demand.

VM Manager: Keeps track of the accessibility of VMs and their resource privileges. It is additionally in charge for moving VMs crosswise over physical machines.

Accounting: It maintains the actual utilization of resources by requests to calculate use costs. Historical utilization information likewise be utilized to improve the service allocation decisions.

c) VMs: Multiple VMs can be progressively begun and stopped on a single physical machine to meet acknowledged requests, hence providing maximum adaptability to arrange different segments of resources on the equivalent physical machine to different specific prerequisites of service requests. Multiple VMs can likewise simultaneously run applications dependent on various operating system conditions on a solitary physical machine. Also, by powerfully migrating VMs crosswise over physical machines, workloads at hand can be solidified and unused resources can be put on a low-control state, turned off or arranged to work at low-execution levels using DVFS so as to save energy.

d) Physical Machines: The hidden physical computing servers give hardware infrastructure to making virtualized resources to satisfy service needs.

B. Proposed Work

Following are the various steps are: -

Step 1 Earliest Completion Time Estimation Phase: For all N data centers, calculate the estimated earliest completion time ($eECT$) for a workflow by assuming that all CPUs in each data center run at their maximum frequencies without considering actual VM allocation.

Step 2 ST Phase: VM migration aware policy called Single Threshold (ST) is used. It is depending upon the thought of setting the upper utilization of threshold for hosts and putting VMs, while keeping the complete usage of CPU beneath this threshold. At each time span all virtual machines are reallocated utilizing the IBFD algorithm with extra state of keeping the upper use threshold not violated. To assess the ST approach, we have conducted a few experiments with various values of the utilization threshold.

Step 3 Data Center Selection Phase: For each available data center that satisfies the deadline requirement, choose the best data center based on workflow completion time, energy cost and $CO2$ emission (ECC) in relation to energy utilization.

Step 4 Forward Workflow Scheduling Phase: A layer based forward task scheduling is performed to the selected data center, and tasks are scheduled from the first layer to the last layer. Earliest completion time ECT is calculated. Each task is scheduled on a specific VM running at the desired frequency as calculated by Step 2. Go back to Step 3 to pick another data center if ECT exceeds the deadline constraint. Step 3-4 is repeated until we find a data center that satisfies the deadline constraint or reject the user request.

Step 5 Backward Workflow Scheduling Phase: Based on the temporary mapping result from Step 4, the resource utilization rate (UR) is further improved by reusing VM and shrinking the idle time between tasks. In this step, a backward scheduling strategy is conducted to adjust the task mapping from the last layer to the first layer while the minimum ECC and deadline is still guaranteed.

The phase diagram research methodology is as fallow:

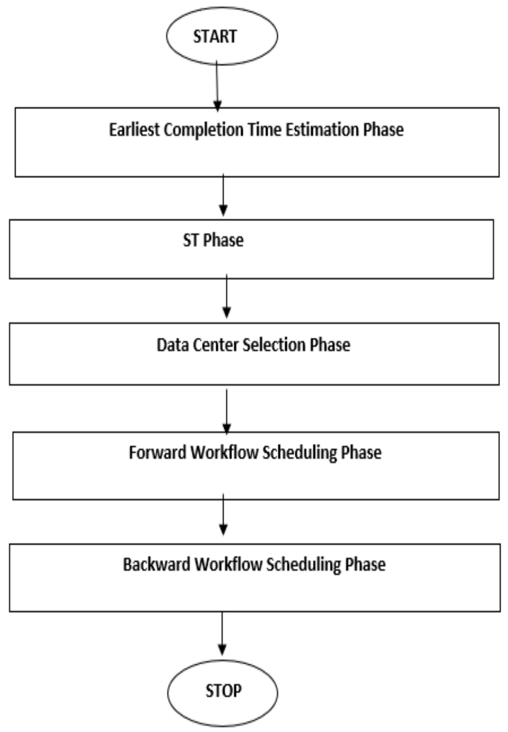

Fig 2: Block diagram of Proposed work

C. Scheduling process in cloud

The primary goal of job scheduling algorithm is to achieve an elite-performance computing and best system or framework throughput. The available resources should be utilized efficiently without affecting the service parameters of cloud. in cloud computing Scheduling process can be divided into three stages they are Resource finding and filtering, Resource chosen or selection, and Task submission [12]. In resource finding datacenter broker finds the resources instant in the system network and gathers status data related to them. During resource selection process target resource is selected dependent on specific parameters of task and resource. Then during task submission task is submitted to the selected resource.

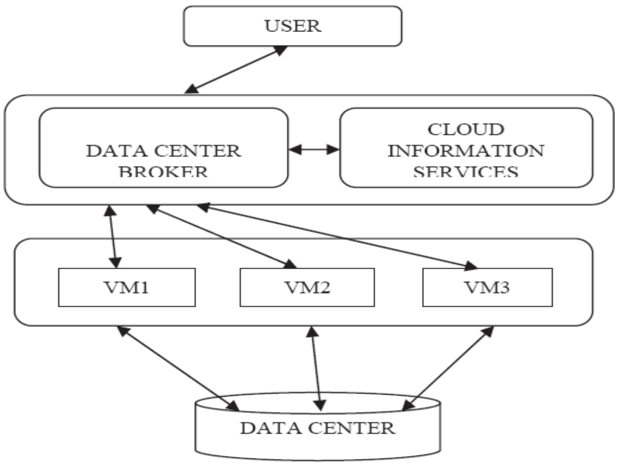

Fig 3: Scheduling process in the Cloud

D. Resource allocation or virtual machine migration techniques.

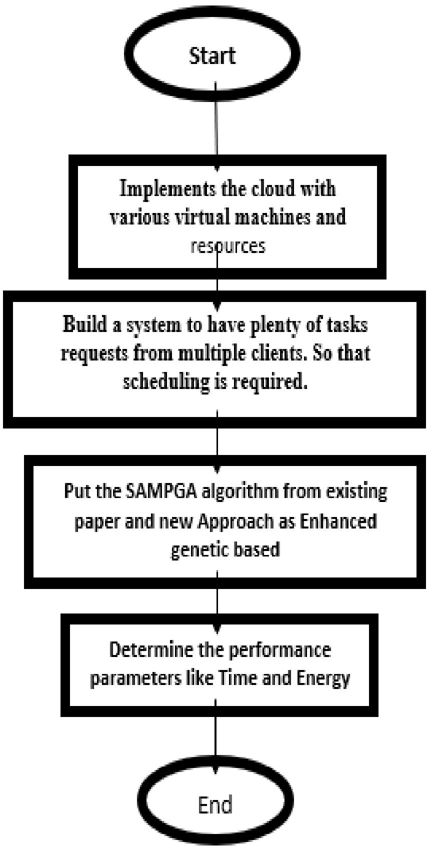

Fig 4: Flow chart of resource Allocation

Step1 in first step we will implements the cloud simulator in eclipse. And put various number of resources and virtual machines.

Step2 in second step we will be having plenty of tasks requests from various types of clients. So that scarcity of the resources can be shown.

Step3 in this step we will schedule the resources using enhanced genetic based algorithm known as Fuzzy with PSO.

Step4 Identify the various performance parameters like energy and time.

E. Performance parameters

1. **Time:** Reduction in time required for execution of request due to less waiting time.
2. **Energy:** Total power consumption for cloud i.e. energy reduction by request completion.

F. Genetic algorithm

Particle swarm algorithm technique

PSO is a dynamic load balancing technique. It can be used in decentralized load balancing. It is used for dynamic decentralized optimum load balancing at broker level.

PSO is a swarm based heuristic optimization technique. It is created by watching the social and biological behavior of swarm intelligence i.e. movement behavior of bird flocks and fish flock. The birds are scattered throughout the searching process for food. While the birds are searching for food from one source to other one, there is always a bird from the bird flock that can sense the food source very well. That bird is perceptible of the lay where the in the group are transmitting the data about their area for the food, it helps them to move closer towards the food source.

That winged creature is detectable of the lay where the in the group are transmitting the data about their area for the sustenance it causes them to draw closer towards

PSO steps

Step1: Set the algorithm parameters: size of population and dimensions, maximum number of

Iterations, Tmax or the expected detected entropy, the inertia weight Wmax, Wmix and the optimal solution set.

Step2: Initialize each population, calculate the fitness value of each particle Fij (x1, x2, x3).

Step3: Particles conduct migration in the system in accordance with each particle's value Fi (x1, x2, x3) in which following the principle: follow the migration process, the particles move to immigration node with the minimal cost (Fi (x1, x2, x3) value is the smallest node) .The fitness value of each particle compare with Pbest, if the current position is better, it will be the best position Pbest;

Step4: For each particle, compare its fitness value and the best position it passed Pbest. If the former is better, take it as current best position.

Step5: Obtain particle's new speed and position based on the formula of iterations. When the load value of immigration node is equal to the total load value /number of nodes of the threshold value of system, then the node is automatically removed.
Step6: the termination condition: the number of iterations reaches the maximum number of iterations set or achieve set detection value (entropy) of load balancing.

IV. RESULTS AND DISCUSSION

Different green computing techniques are used by many researchers for consumption of energy in the cloud. In this study, results are analysed using green cloud computing technique. Genetic Algorithm is used along with Resource allocation or virtual machine migration techniques, Single threshold policy and DVFS policy. The whole work is done by simulator toolkit CLOUDSIM-3.0.3.
For the benchmark experimental results, a DVFS policy has been used yet it doesn't not perform any adaptation of allocation of VMs in run-time. The DVFS techniques leads to the total energy consumption with respect to Resource allocation or virtual machine migration techniques, Single Threshold (ST) policy as shown in tables.

Resource allocation techniques					
CloudLet Id	Status	Load	Time	Cost	Generations
0	SUCCESS	5.4507	40.5734	86.1447	66.0

Table 1: Resource allocation or virtual machine migration techniques

Single Threshold (ST) policy					
CloudLet Id	Status	Load	Time	Cost	Generations
0	SUCCESS	1.47	19.5664	44.3245	42.0

Table 2: Single Threshold (ST) policy

Dynamic Voltage frequency scaling technique (DVFS)					
CloudLet Id	Status	Load	Time	Cost	Generations
0	SUCCESS	0.87	13.21	33.19	31.0

Table 3: Dynamic Voltage frequency scaling technique (DVFS)

The simulation results are presented in table. The proposed technique identifying the best report from the cloud allocated to the request so that the time taken for the execution of task can be minimise which is directly reduces the energy requirement for the cloud execution after the completion of time resources completely shut down to take the energy and vision of co2.

The energy consumption in cloud infrastructure can be significantly reduced with respect to Resource allocation or virtual machine migration techniques, Single threshold policy and DVFS techniques. The development of the utilization threshold energy consumption diminishes, SLA violations increases. This is because of the way that higher utilization threshold allows more aggressive consolidation of VMs, by the cost of the increased risk of SLA violations.
Results of Resource allocation or virtual machine migration techniques, Single threshold policy, DVFS techniques with respect to Load, Time, Cost and Generation show graphically as fallows.

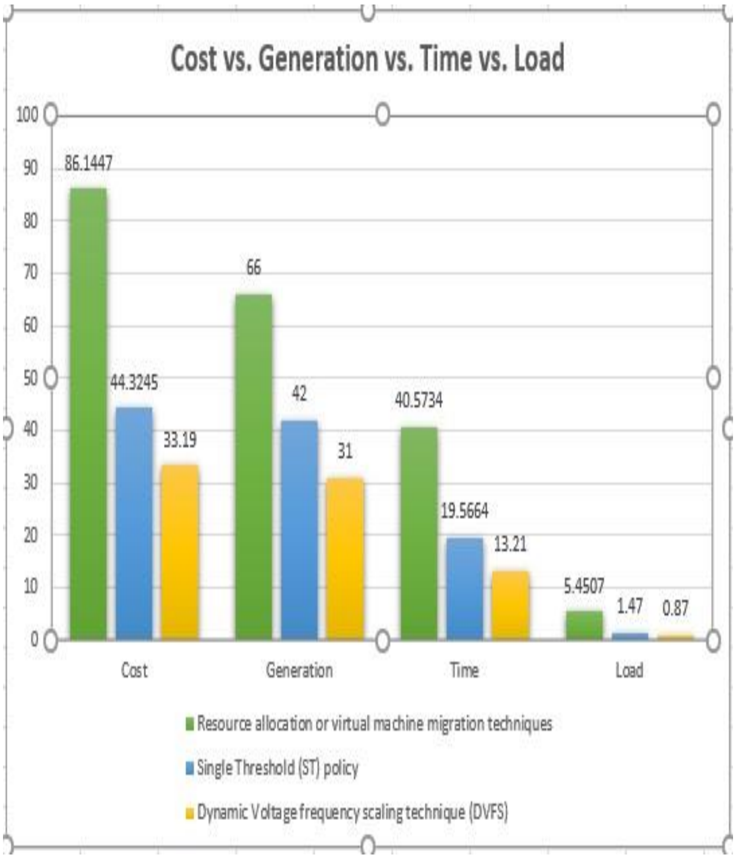

Figure 5: Energy consumption in cloud infra structure

Percentage improvement for Single Threshold (ST)Policy and Dynamic Voltage Frequency Scaling Technique (DVFS).

Comparison of performance

Parameter	Single threshold (ST)Policy	Dynamic Voltage Frequency Scaling technique (DVFS)	Percentage Improvement
Load	1.47	0.87	40%
Time	19.56	13.21	32%
Cost	44.32	33.19	25%
Generations	66	31	26%

Table 4: Percentage Comparison of performance

Table 4 shows the percentage improvement for the proposed technique in comparison to the base technique. The proposed technique based on Dynamic Voltage Frequency Scaling Technique (DVFS) is having all the parameters improved. It has improved on all Load, Time, Cost and generations.

The percentage improvement for the proposed technique in comparison to the base technique
Shown graphically as below.

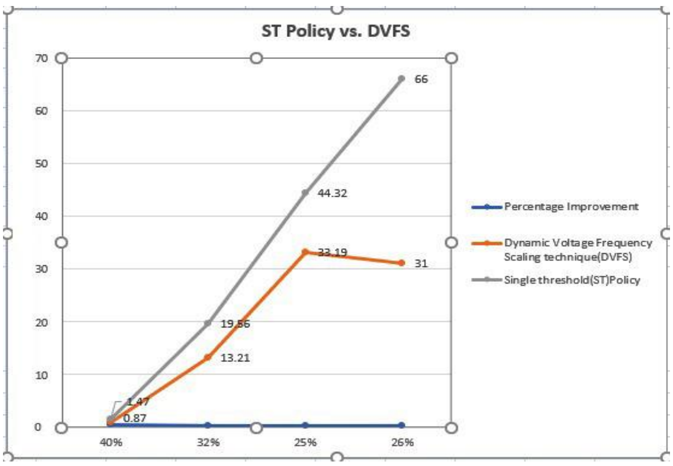

Figure 6: Percentage Comparison of performance

V. CONCLUSION

Cloud computing is developing as a significant move as the present organizations which are facing extreme information overload and skyrocketing energy costs. Green Cloud architecture or design, that can help consolidate workload and accomplish significant energy saving for cloud computing environment, in the meantime, guarantees the real-time performance for many performance-sensitive applications.
In the future, there are still a number of research activities that we plan to carry out, which could improve the performance of Green Cloud and bring solid value to users to accomplish their business goals and their social responsibility in Green IT. Applying green innovations is exceedingly basic for the sustainable development of cloud computing. the different green methodologies enquired, the DVFS technology is a highly hardware dependent approach and subsequently less flexible. Green scheduling algorithms depend on neural predictors can prompt to a 70% power savings. The ST policies likewise enable us to cut down data Centre energy costs, in this manner prompting a strong, focused cloud computing industry. End users will likewise benefit from the decreased energy bills. As a conclusion, Green Cloud successfully saves energy by progressively adjusting to workload leveraging live VM migrations, in the meantime meeting system SLAs.

VI. REFERENCE

[1]. Perera, C., Qin, Y., Estrella, J. C., Reiff-Marganiec, S., Vasilakos, A. V., "Fog Computing for Sustainable Smart Cities: A Survey," ACM Computing Surveys (CSUR), vol. 50, no. 3, pp. 32:1 - 32:43, July 2017.

[2]. Varghese, B., Wang, N., Nikolopoulos, D. S., Buyya, R., "Feasibility of Fog Computing," 19 Jan 2017. [Online]. Available: https://arxiv.org/pdf/1701.05451.pdf. [Accessed 30 July 2017].

[3] R. Buyya, C. S. Yeo, S. Venugopal, J. Broberg, and I. Brandic, "Cloud Computing and Emerging IT Platforms: Vision, Hype, and Reality for Delivering Computing as the 5th Utility", Future Generation Computer Systems, Elsevier Volume 25, Issue 6, pp. 599-616, June 2009,

[4] Kalange Pooja R1, "Applications of Green Cloud Computing in Energy Efficiency and Environmental Sustainability", IOSR Journal of Computer Engineering (IOSR-JCE), ISSN: 2278-0661, ISBN: 2278-8727, PP. 25-33, Dec, 2016.

[5] Ye, K., Huang, D., Jiang, X., Chen, H., and Wu, S. (2010). "Virtual machine-based energy-efficient data center architecture for cloud computing: a performance perspective", In Proceedings of the 2010 IEEE/ACM Int'l Conference on Green Computing and Communications & Int'l Conference on Cyber, Physical and Social Computing, pages 171-178. IEEE Computer Society.

[6] Fei Cao, Michelle M. Zhu., "Energy Efficient Workflow Job Scheduling for Green Cloud," in Proc. of IEEE 27th International Symposium on Parallel & Distributed Processing Workshops and PhD Forum, pp. 2218-2221, October 2013.

[7] Seema Vahora, Ritesh Patel, Hetal Patel and Sandipkumar Patel" Efficient Virtual Machine management based on dynamic workload in cloud computing environment", in IEEE International Advance Computing Conference (IACC), India, June 2015.

[8] Amazon. Elastic Compute Cloud (EC2). http://www.amazon.com/ec2/.

[9]. J. Xu, J.A.B. Fortes, "Multi-Objective Virtual Machine Placement in Virtualized Data Center Environments", IEEE/ACM Int'l Conference on Green Computing and Communications & Int'l Conference on Cyber, Physical and Social Computing, Hangzhou, China, pp.179-188, 2010.

[10] Atiewi, S., Yussof, S., Ezanee, M., & Almiani, M. A review energy-efficient task scheduling algorithm in cloud computing. IEEE Long Island Systems, Applications and Technology Conference (LISAT), June, 2016.

[11]. Rajkumar Buyya, Anton Beloglazov, Jemal Abawajy," Energy-Efficient Management of Data Center Resources for Cloud

Computing: A Vision, Architectural Elements, and Open Challenges", The University of Melbourne, Australia, June 2010.

[12]. Pinal Salot, "a survey of various scheduling algorithm in cloud computing environment, International Journal of Research in Engineering and Technology, ISSN: 2319-1163, Volume: 02 Issue: 02, page 131-135, Feb-2013.

VII. BIOGRAPHIE

Mohammad Ilyas Malik, is pursuing M.Tech Degree Desh Bhagat University in Computer Science Engineering, Punjab, India. Area of interest is cloud computing, ENERGY CONSUMPTION IN SLA VIOLATION OF ST POLICY