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Load Balancing Optimization for Green Cloud Environment Using Effective Scheduling

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Abstract: A solution of the green cloud is not only to save the consumption of energy but expressively reduce operational costs. The main objective is to make the comprehensive computing influence of a vast collection of resources offered to a single application. High consumption of energy is the main concern in green cloud computing because of high computations happened in tightly connected data centers that need managed resources and smooth operations. The research is implemented on green cloud computing based on the scheduling process for energy conservation which is the main concern. The groups deal with the high efficient arrangement in which every industry is required with high uniformity, scalability, and effective performance over different cloud computing scenarios. This research work deals with the efficient performance to achieve efficient load balancing and the optimization process for high energy efficiency which will be the key feature of our proposed system. The proposed work deals with the hybrid scheduling process i.e. priority-based weighted round-robin and minimum completion time to reduce the energy consumption in green cloud systems. The performance will be evaluated for low error rates and achieve high energy efficiency to balance loads of the requests.

Keywords: Energy sustainability, scheduling, cloud computing, load balancing, Green cloud computing, Energy efficiency, Data centers, Cost, Scheduling, Virtualization, Node, Parallel processing, Schedulers.

I. Introduction

The word green in green computing denotes an environment-friendly process. The perception is to decrease energy depletion and reduce wastage in the environment. Before moving further to the procedures used in the green cloudlets recognize what is the meaning of cloud computing and how it is adjusted in organizations nowadays. The cloud computing perception has reduces the efforts without any physical server [1]. The IT business was used in estates to associate servers in the server quarters. Cloud computing entirely removed physical servers from societies and eases every individual related to the IT industry to work remotely. As cloud computing practice increased, consumption of the energy of the machines also increased. This upsurge in consumption of the power has resulted in a significant rise in carbon productions in the atmosphere [2]. The rise in energy depletion is due to the rise of server machines and other structures in the organization exponentially. The decrease in the consumption of energy will reduce emissions of carbon in the atmosphere. To shrink energy depletion, cloud computing is discovering efficient energy conservation approaches for ease of utilization and ways of working. Green computing is to create an energy-saving process to diminish carbon emissions to the network[3][4].[1]

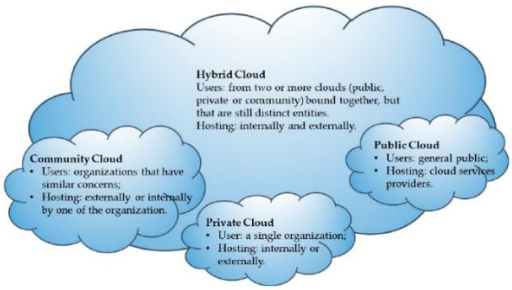

Figure 1: Cloud Environments [3]

1. Green Computing Advantages

There are various benefits of green computing and the main ones are discussed below.

a. Energy Conservation Approaches

In 2013, Google sponsored a plan to measure the use of the power and carbon production of cloud computing scenarios. The volume of constant power spent for common implementation of the software systems like working on the spreadsheets, electronic mail, and CRM arrangements to the cloud is estimated to diminish total energy consumption by 80% (approx.). Cloud computing knowledge reduced power consumption to a level. Earlier in cloud computing processes, the machines were positioned in the server rooms and required a constant supply of control to keep those machines running

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successively. Alongside the servers, a lot of energy was required for the cooling systems to confirm they are not at high temperatures. As the life for the machines and coolers end, they need to be replaced. With cloud computing systems, the hardware is reduced so is the decrease in consumption of the power. Nowadays the combination of green computing and cloud computing, the main goal is to shrink power consumption as much as possible for the smooth functioning of the machines [5].

b. Reduction of the carbon footprints

The green cloud computing benefits seen in the business today are remote locations and elasticity to work from any place and without any time constraints. Remote location work is one of the main principles that organizations have seen today. This elasticity has improved efficiency and condensed the daily transformations of workforces to the workplace. This cutting edge has reduced fuel depletion and carbon production in the atmosphere. This has advanced organizations to reduce the real estate costs with consumption of the power at the office locations [12][16].

c. Paperless using green computing

The cloud is harmless to store information. Storage of collections in clouds is beneficial as it deals to access important information anytime and at any place. The other significant part is that data can't be lost due to its high security as the data is stored in the secure hard drives in the server rooms [17][18].

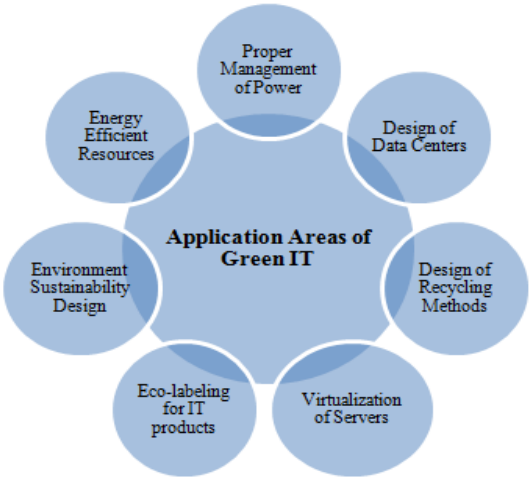

Figure 2: Application areas covering green cloud computing [2]

Green cloud technology has several possibilities for various systems to go entirely paperless. The computing storage possibilities like Google Drive, drop boxes, Microsoft one drive systems are in widespread use nowadays. The protected cloud computing green expertise has led out the necessity to print booklets. These green computing implementations allow operators to sign, supply, and send bonds and legal papers in seconds with very few clicks. Green computing can manage knowledge resources with enhancement in efficiency and a reduction in costs. The green cloud structural design is working to diminish power depletion while still providing resourceful services to the consumers. The power controlling in cloud systems using green procedures is implemented in the planning [13][20].

d. E-Waste reductions

Electronic unwanted systems are increasing from time to time. This dumping of waste into the atmosphere is causing damage to the network and human well-being as well. Normally, 24 million CPUs are disposed of in the U.S. 18% of processers are contributed or recovered. The e-waste additionally goes over a trade sequence in developing nations where they are smuggled. The waste goes over scrap managers, reuse parts, and the remaining is burnt. The e-waste which was burnt was causing pollution in the environment [19][21].

2. Deficiencies in Green Computing

If there are benefits of the green cloud environment then there exist some deficiencies also which are discussed below.

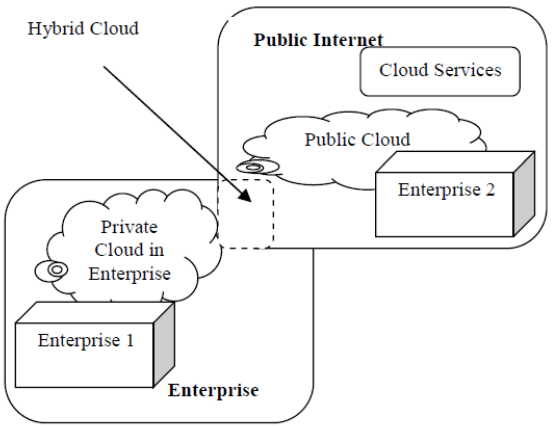

Figure 3: Deployment Process in green computing [2]

a. The implementation process is highly costly

The investment for green computing is measured to be extraordinary by small and medium administrations. The reality is, it is still challenging for the investment purpose in green cloud computing. The technology of the green cloud is evolving, so it is somewhat interesting for one and all to adapt closely [14].

b. Under Power consideration

As the main objective is energy conservation and to reduce energy consumption, the applications that want high power requirements to accomplish their tasks would get influences using green computing technology [22].

3. Two main approaches associated with Green Computing

Organizations are executing the subsequent green computing methodologies in their locations.

a. Use of virtualization process

Virtualization is a method wherein several operating structures run on a processer at the same time without any disturbances. The applications successively look as if they are on their machines. The use of collective servers and allocation of the terminal is found to save power up to some extent [23].

b. Management of Power supplies

Electricity transmission results in 30% of power wastage and having utilization of 70%. With green computing expertise, energy will be recycled proficiently. The management of the energy and their supplies in computing scenarios is reducing the power consumption by 70% [24].

II. Problem Formulation

Nowadays, green cloud computing is a vast research area that is demanding and emerging. The aim is to make use of the cumulative computing influence of resources accessible to a single application. The presence of energy-efficient and low-cost green cloud mainframes like high power processors and computer units made cloud procedures applicable in terms of software ethics for the development of green cloud environments [25]. The data centers in green computing consume a lot of power for the service executions and cause problems that could be explained but are not implemented on much larger problems and could become controllable. But as data streams are random and having a high processing load as requirements are not able to complete appropriately by the servers which causes a big problem in the real world. So it is essential to manage and load the processes and requests to be well-adjusted ineffectual routine to schedule and balance the loads. This research work comprises efficient evaluation of the machines to perform load balancing and the optimization for high productivity for less energy consumption which is the main feature of the proposed method [26][27].

III.Related Research Work

The overall study is based on the various real-time application used in a section of the introduction of this paper. Green cloud computing covers different main modules on which its implementation depends and is given below [28]:

- Parallel Processing.
- Balancing and distribution of the load.
- Task scheduling.
- Architectures of the cloud.
- Minimum execution times of the processes.
- Virtualization [29][30]

This part shows efficient investigations done by experts on different energy minimization of energy in green cloud systems. P. Geetha, C. R. Rene Robin et al. [6] worked on an actual resource allocation structure for cloud operators, which are relied on service quality using two structure coatings i.e. cloud manager and green manager. The first layer i.e. cloud manager is in charge of indicating the proper resources out of all presented resources and the second layer i.e. green manager opt-out of the top one out of those resources. Due to this finest collection of resources, the typical service execution time is decreased at the cost of reduced power depletion. When managing 500 service requirements, their planned work absorbs about 4200 Watt (approx.) and the traditional approaches consume extra energy. Abdulaziz Alarifi, Kalka Dubey et al. [7] proposed a hybrid approach i.e. energy-efficient hybrid structure for refining the effectiveness of intense electrical power in data centers and their evaluation. Their planned structure is grounded on the scheduling and server procedures rather than dependent on only one process present in the other traditional approaches. The proposed framework evaluates the processes or the tasks according to execution and need of energy before obtaining any scheduling process. It covers the scheduling process that reflects the consumption of energy when performing scheduling activities. Yongjian Liao, Ganglin Zhang et al. [8] proposed an efficient technique of the decryption of the feature that helps to perform security tasks to the cloud environment. Though, the cloud server desires to replicate the decryption service using complex ciphertext for different users sustaining the same admittance policy in their security arrangements. Green computing is the thermosphere reliable environment and recyclable deployment of various useful resources. The networks based on the green cloud can decrease their cost of development or energy necessities by adjusting their routine, improving resource control services. Riman Mandal, Manash Kumar Mondal et al. [9] proposed an efficient power-aware selection policy using virtual machines as a result of which they have proposed migration of the VM in an optimized way. Their projected VM selection strategy for efficient energy consumption is additionally estimated using a trace-based simulation process. These vast data centers absorb heavy power on a big scale that outcomes in a highly effective charge. The enormous carbon outline from the power producers is a very big issue to create global warming and it's crucial to lower the emission rate of the carbon and consumption of energy up to great extent. Srimoyee Bhattacherjee1 · Rituparna Das et al. [10] worked on a systematic study of the several practices that help in reducing energy depletion in data center services. The main objective of their study is to create the

environment greener. In their planned work, the prediction approach has been implemented and realized on the prevailing migration policy for traditional data histories by using the thresholding process. Rigorous mock-ups have been directed, and the outcomes show decrease energy consumption in the data center. Qiheng Zhou1, Minxian Xu et al. [11] linked several energy-efficient systems from several perspectives, with planning, modeling, and performance evaluations. They also evaluated and implemented these systems with the same new settings in the CloudSim environment. Finally, comprehensive considerations of these procedures are delivered. Green cloud computing is essential to confirm productivity and sustainability using energy-efficient techniques. One of the foremost methodologies is to relate energy-efficient procedures to improve efficient usage of resources and power consumption. Presently, countless virtual machine-based energy-efficient systems have been suggested to diminish the power deletion of the green cloud environment.

IV. Proposed Work

1. Proposed Evaluation

The proposed work covers the simulation environment on the green cloud process for efficient load balancing. The load balancing process will cover the smooth functioning of the execution of the requests and balances the flow of requests on the machines. The execution of the no. of the requests should not have much waiting time in the queues which will overcome the problem of energy consumption in the data centers. The simulation is taken place in the MATLAB 2018 or above version. In this research, MATLAB is chosen because it's a strong technical computing tool used to analyze the complexities of the execution algorithms and is organized in such a manner that the make best utilization of memory for the execution.

Table 1: Simulation Setup

S No	Component Name	Value
1	Processor	I3 or above
2	Software	MATLAB 2018 or above
3	RAM	4GB or above

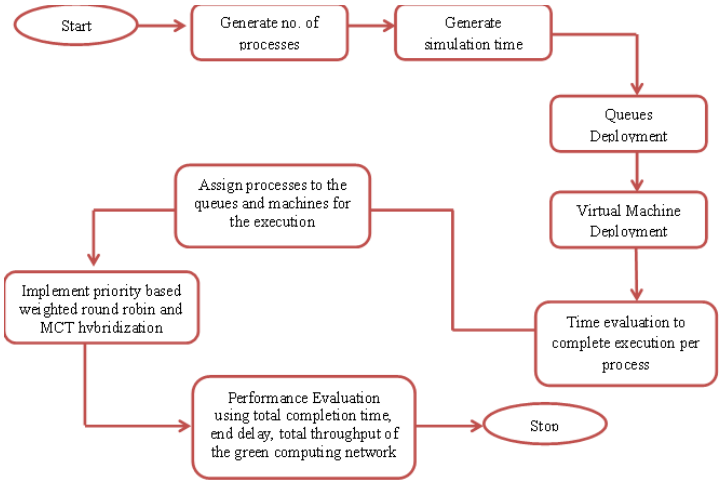

Figure 4: Proposed Model

2. Proposed Algorithm

Step 1: Start

Step 2: Adjust Jobs such that $\mathrm{Np(i)} = 1$ to n and Simulation time $T(x)$

Where $\mathrm{N(p)} \rightarrow$the number of processes is allocated to the machines and n is the number of process limits.

Step 3: Generate arbitrary initial energies E(x) and the arrival time of the job $A(t)$

Step 4: Store the ids of the tasks in the array $A(x)$

Step 5: Perform queues deployment K{tp} in such a way that $\mathrm{tp} = 1, 2, \ldots$ n and virtual machines $M(tx)$ such that $\mathrm{tx} = 1,2,..,5$

Step 6: Create the burst interval for the accomplishment of the tasks.

Step 7: Initialization of the process completion arrays C{x} where $\mathrm{x} = 1$ to N for the accomplishment of processes

Step 8: While isCompleted(Np)

Allocating weights Wts[x] → K i.e. queues

Check for the high priority queue consuming high priority Wts[x]

End While

Step 9: Allocate process to the high queues and finishing through VM's having good bandwidth for the least completion process time.

Step 10: Estimate the time desired for the process and store the process id for the up-to-date accomplishment of the job.

Step 11: For i = 1: job count

If $\mathrm{Curr(t)} < \mathrm{T(x)}$

Evaluate the total energy consumed, complete processes, and execution time for the process.

End If

End for

Where $\mathrm{Curr(t)} \rightarrow$ current time and $\mathrm{T\ (x)} \rightarrow$ time required per job

Step 12: Estimate the Task for the unfinished processes after the burst time.
Step 13: Evaluate the least execution time process to find the process which is completed and acquire minimum time to accomplish.
Step 14: Evaluate the energy consumption to complete the number of processes.
Step 15: Evaluate the end delay; throughput and finishing time taken by VM's to execute the processes in parallel
Step 16: Stop

3. Results and Discussion

This section covers the result and simulation implemented for the load balancing and energy consumption process in the green cloud computing which is implemented using MATLAB environment. As it was earlier mentioned that MATLAB is an efficient technical computing tool for algorithm analysis and fast execution of instruction set, the same consideration is taken for the proposed simulation to make the application scalable and reliable as per the requirement of the green cloud environment.

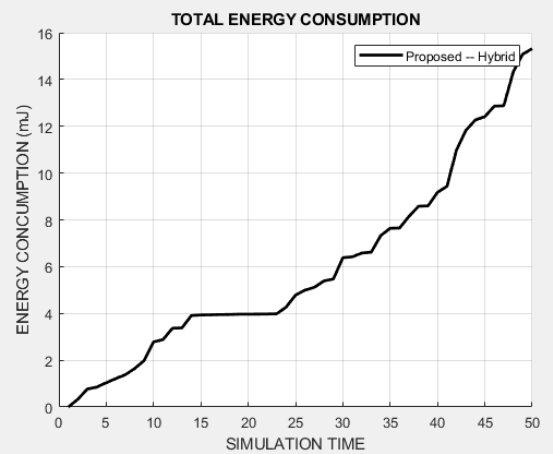

Figure 5: Energy Consumption

Efficient usage of the power by the workstations or the virtual machines is a bit constraint in the data centers. As the resource requests increase instantly, more power consumption will be required to execute those resources which require the balancing of the load. The proposed approach can achieve low energy consumption which is the desired output and successful execution of all the tasks on the machines with load balancing. The energy consumption should not be high because if the consumption of the power increases the machines can get overloaded and it can burst out the machine which can stop the valuable resource allocations in the green cloud environment.

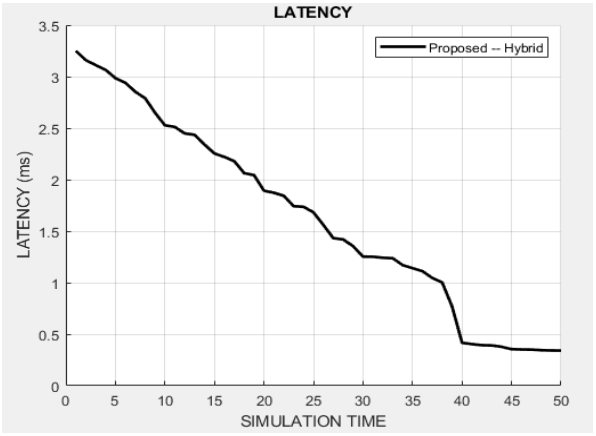

Figure 6: Latency

Latency is a very significant performance parameter in the cloud computing environment. The latency should not be high. If it gets high, the waiting time of the requests or tasks increases in the queue which can overload the queues and can drop the number of necessary requests required for the resource allocations. As a result of which the load on the green cloud processes increases and the performance gets degraded which is not the desired output. Fig. 6 shows the latency of the proposed work which shows that the proposed hybrid approach is achieving low latency for the execution of the processes in the green cloud environment.

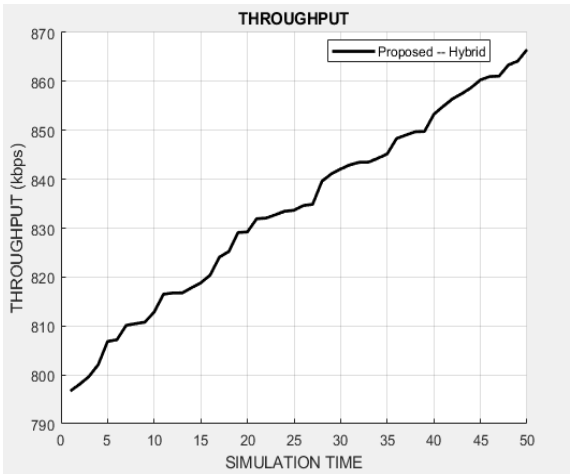

Figure 7: Throughput

Fig. 7 shows the throughput achieved using the proposed work and is desirable. The throughput of the proposed work deals with the successful completion of the number of resource allocation processes concerning the total number of tasks assigned to the virtual machines for the execution. The throughput must be high because the energy consumption of the machines is completely dependent on the throughput and if energy consumption increases the machines get overloaded and it will reduce the flow of execution of requests and as a result of which

the through can be decreased which is not the desirable output.

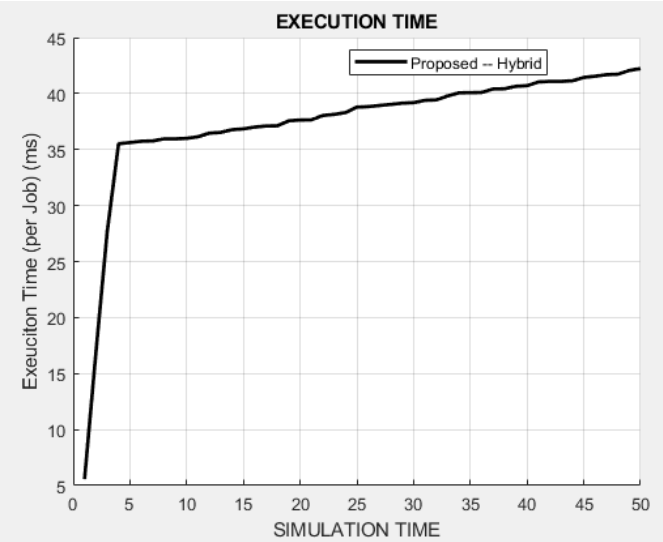

Figure 8: Execution time

Fig. 8 shows the execution time of the completion of the resource allocation tasks for the balancing of the load in the green cloud environment. It shows the number of requests is executed with minimum completion time which is our desired output and it's increasing because of energy consumed by the machine for the fast execution of the processes in the cloud environment. It can also be noticed that the proposed approach is achieving very little time in a range of 35-43 ms which is a desirable output of any cloud environment.

Table 1: Performance using MCT

EC (mJ)	ET (ms)	LT (ms)	TH(kbps)
5	8	100	10
67	24	470	120
130	42	900	350

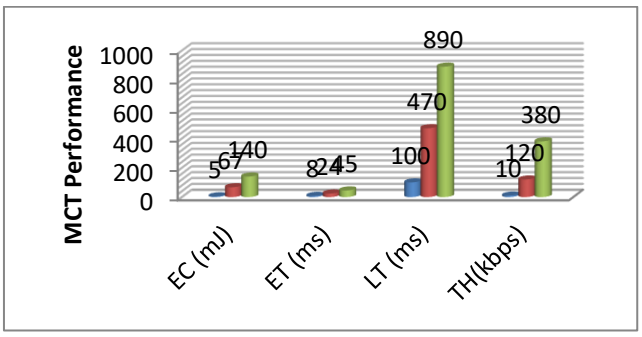

Figure 9: MCT Performance

Table 2: Performance using MET

EC (mJ)	ET (ms)	LT (ms)	TH(kbps)
3	3	2×10^3	30
35	19	3×10^3	290
60	38	5×10^3	470

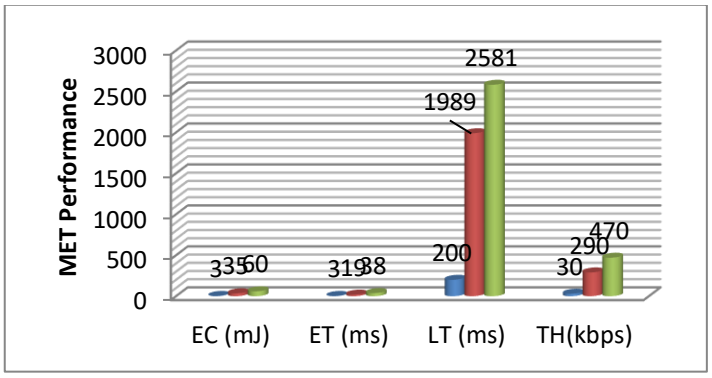

Figure 10: MET Performance

Table 3: Performance using Hybrid Proposed

EC (mJ)	ET (ms)	LT (ms)	TH(kbps)
0.9	0.09	0.001	50
6.5	0.28	0.029	467
13	0.67	0.09	679

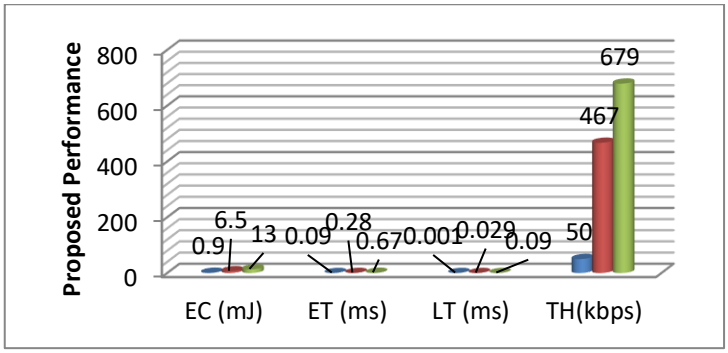

Figure 11: Proposed Performance

Table 1, 2, 3 shows the performance analysis using MCT scheduling, MET, and our proposed hybrid approach. It can be seen that the proposed approach is performing well and are achieved outcomes in terms of the high-performance green cloud system.

V. Conclusion

The research work has been carried out with load balancing using a Scheduling process. Hybrid scheduling is utilized for efficient performance of the energy consumption, Load balancing, low latency, low execution time for the completion of all the resources allocated for the processes, with the help of high throughput power distribution has been scheduled for the proper execution of the task completed by the virtual machine for the virtulization and migration performance on the green cloud environment. It is very crucial and need to provide controller on regular basis by giving proper attention to the scheduling processes. Out proposed work is achieving low energy consumption i.e. 15 mJ to execute all allocated processes (WRR, MCT, OLB, MET)with high throughput and with low latency i.e. 0.3 ms on the execution of the processes on the machines. Eventually, it has been proved that the

research approach reduces reduce the constraints occurring on the green cloud dynamic environment to perform proper load balancing and management of the resource allocations.

VI. Future Scope

The future work deals with predictive modeling using machine learning and deep learning to predict the CPU utilization levels in green cloud computing.

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