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Tasks scheduling with lessen Energy usage over a cloud server using Hybrid adaptive Multi-Queue Approach

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ABSTRACT- Energy consumption high is one the major problem of cloud computing systems. Recent jobs computing environments have the randomness nature and calculate the nodes have to be powered on all the time to await incoming jobs. Green cloud computing is model for enabling convent, environments sustainability in It sector that can be speedily provisioned and released with minimal management effort or green provider interaction. The main advantages of the power saving mode; it can use sleep mode, hibernate mode in which energy consumption are less. The green cloud computing solves the major issues of increase with increase in energy consumption. The main aim of green cloud computing is reduce the energy consumed by physical resources in data centre and save energy and also increases the performance of the system. There are several scheduling algorithms such as Adaptive Min-Min Scheduling Algorithm; Multilevel Feedback Queue Scheduling Algorithm etc. are utilized in green cloud computing to lower the energy consumption and time. So, to solve this problem, in proposed work one scheduling algorithm will be implemented which is Multilevel Feedback Queue Scheduling algorithm. On the basis of them, energy consumption takes place will be reduced after using improved Adaptive Min-Min Scheduling Algorithm. Check the performance of the proposed method using energy and time parameter.

Keywords: Energy consumption, green cloud computing, Adaptive Min-Max Scheduling and Multi-level back Queue scheduling algorithms.

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1. INTRODUCTION

A novel computing model, cloud computing takes the adjustment and transformation of the information technology industry. With its growing dissemination, applications and cloud [1] computing not only offers huge opportunities, but also appearances many challenges in its expansion process. The energy consumption in a cloud data-centre is on the increase, though the possessions themselves are highly under-utilized this currents a block that limits the development of cloud computing. The energy consumption in a cloud computing system contains of energy consumed by dissimilar varieties of electrical apparatus.

The past years, cloud computing has concerned significant kindness and it has speedily emerged as a widely used accepted computing process. The expansion and study public has quickly stretched consensus on core concepts such as on demand calculating properties, elastic ascending, working expense and removal of up-front principal and creating pay as you go occupational model for computing and IT services. Through cloud computing has been mostly used adopted by industry, the study on cloud computing is still at an early stage. Various previous problems have not been fully addressed, through novel challenges keep emerging from industry requests. Energy organisation is one experiments study [2] problems. Infrastructure of the cloud is the most widely significant component in a cloud. It may include tens of thousands of servers, disks and system devices and normally serve millions of users worldwide. Such a huge scale data-center will ingest considerable quantity of energy [3].

The simple concept of cloud computing is about since the early 1950s, through the term wasn't invented back then. Time sharing networks was how it was lectured back then. Through the historical of 1960-1990, a host of specialists did suggestion the era of cloud computing in their records or estimates. The duration dumb incurable attached to the mainframes was more eminent in this period, in-lieu of the term cloud computing. In the early 1990s, even the communications businesses instigated offering Virtual Private Networks instead of enthusiastic connections, which were dressed in QoS but were reasonably inexpensive [4].

Cloud computing can be measured as an order of perceptions, which includes of several models. The first model is the Service Model [11] which further contains three simulations explicitly;

- Software as a service,
- Platform as a service and
- Infrastructure as a service.

Second is the Deployment model [5] which additional includes of public cloud, private cloud, community cloud and hybrid cloud.

Allowing to National Institute of Standards and Technology – "the main impartial of cloud computing is to exploit the collective properties and at the same time the drawback is its high organization cost and redundant power consumption."

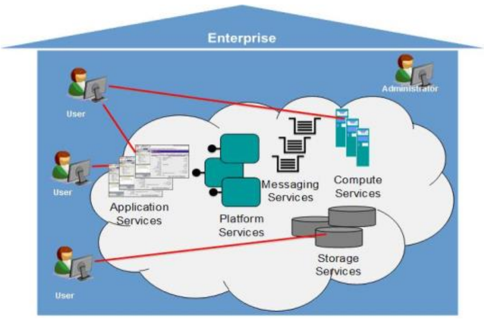

Figure 1: Environment and Cloud

Allowing to National Institute of Standards and Technology – "the main disconnected of cloud computing is to exploit the shared resources and at the same time the difficulty is its high substructure cost and needless power consumption.[6]"

It is vibrant from Figure 1 that in cloud situation power consumption is very high with high carbon production whereas at the identical time in green cloud this is very fewer as likened to outmoded cloud. Green clouds avoid power depletion and this is the aim for adoption of this technology by IT companies like Google, Microsoft, Yahoo!, etc. [7]

1.1 Green Computing for a Sustainable Future

Green-computing, the study of ecological-computing is nowadays under the gallantry of not only environmental organizations but also from other large and medium sized organizations. [8] Green computing uses the innovative techniques to reduce the impact of the industrial processes caused by growing population. The main aim is to use the natural resources so that they cannot be diminished lastly.

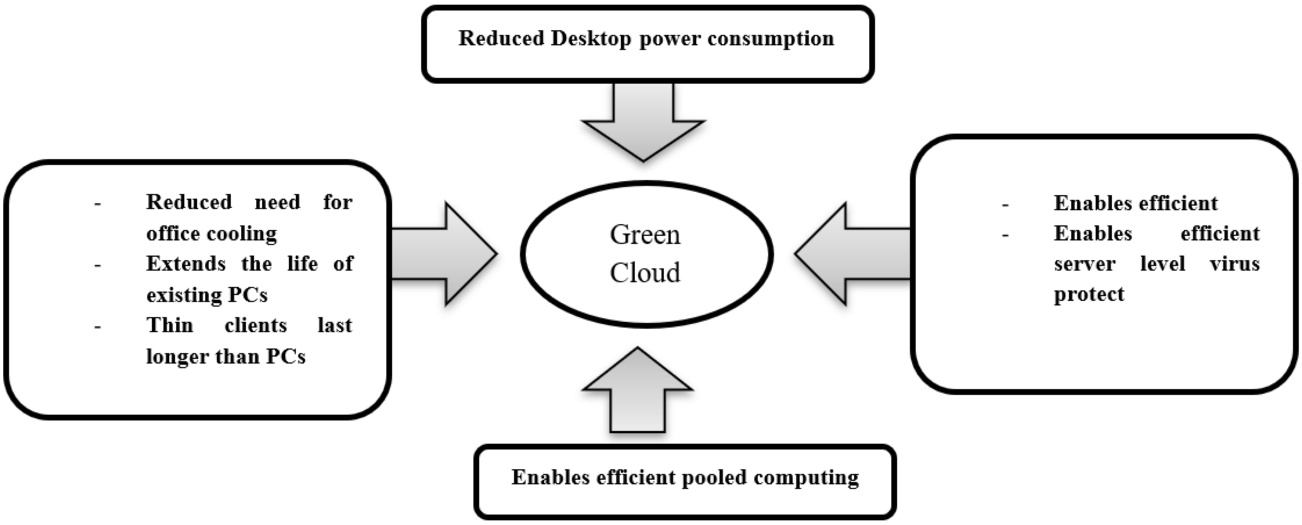

Figure 2: Green Cloud Computing Benefits

Green computing aims to extend the maturation of the product and thereby increasing the reusability of the product. There is one main method called computer virtualization that mainly [9] leads to the green computing technology. The main objective in using green computing is to reduce power, energy consumption and thereby enhancing the performance of the system. Green computing minimizes the waste by sharing computers, resources etc. or turning off the light when not in use. Green computing can be achieved via increasing the resource reusability. Following methods has been used to increase the use of the green computing:

- Green Use- By minimizing the electricity consumption and increasing the use of the portable devices.
- Green Disposal- Electronic waste recycling e.g. by remaking an existing computer.
- Green Design- Efforts to improve environmental quality while increasing the environment development.
- Green manufacturing- Economic welfares include long-term cost saving as well as waste reductions.

Following are few mentioned reasons for going green:

- Computer energy is often wasteful.
  – Shut down the computer, when not in use.
  – Use LED rather than tubes.
- Printing papers
  – Do not print unnecessarily.
- Pollution
  – Use eco-friendly ways for travelling.
- Reducing Energy Consumption
  – Shut-off the room lights when not in use.

1.2 Scope of Study in Green Cloud Computing
Green computing has freshly become a major research topic due to its various economic and environmental impressions. Current studies have shown that the quantity of greenhouse gas emissions shaped by computers, communication systems, and other information and communication technologies [10] alone is almost equivalent to that of the entire aviation industry. Furthermore, according to many studies, ICT and computing possessions explanation for 2% to 10% of the world power consumption, due to the ever cumulative diffusion of electronic devices. Green Computing, Networking, and Communications Symposium aims at transporting together researchers and prophets from academia, research laboratories, and trades working near the eventual goal of green ICT. To this end, this symposium solicits innovative theoretical, new, and design methods that can cope with this pattern shift towards green computing.

1.3 Thermal Reactive and Proactive Scheduling and Cooling

1.3.1 Proactive Approach
The data-centre management can be observed as proactive of it programs and requirements the properties in irregularity escaping way. In this paper we endure to thermal irregularities such as maximum inlet infection destruction and overcooling. A proactive approach necessitates preparation which [11] includes calculation and estimate. A calculation can be of thermal map after a batch of jobs is programmed and may necessitate building of thermal profiles of attendants or racks. A thermal profile provisions the trend of temperature change within or at channel air aisle of the server with the revolution in workload. In this paper we attention on CPU utilization as a measure of workload. Thermal profiles of exceptional tasks such as standards and software submissions can also be shaped.

1.3.2. Reactive Approach
A reactive approach takes phases after an anomaly has happened. It is the organization without planning. A reactive method does not require calculation and estimation. Neither is it required to preserve thermal profiles. It achieves remedy procedures after the happening of an incongruity. For example after the inlet infection of a server has surpassed the maximum threshold. A reactive method can thus lead to adversity such as equipment disappointment due to warmness. But a reactive method is faster than proactive approach [11]. It displays the real time situation.

2. SYSTEM MODEL
The use of Green Cloud Computing has augmented significantly in the current past. A lot of examination has been done to integrate and improve the applicability of Green Cloud in real life circumstances with this help of numerous parameters. Practice of energy is intensely surges in data centres. Cavdar *et al.*, familiarized for humanizing the energy efficiency of the running data centres, the Green grid is suggesting some parameters like Power Usage Efficiency and Data centre Efficiency metrics, Thermal Design Power, *etc*. The use of Green Cloud Computing has increased substantially in the recent past. A lot of research has been done to include and enhance the applicability of Green Cloud in real life scenarios with help of these various limits. Usage of energy is melodramatically increases in data centres.

A.Jain et.al, [12] discusses that the large amount of CO_2 degeneracy in atmosphere has generated the necessity of Green computing. More processor-chips produces more temperature, more heat requires more cooling and cooling over produces heats and thus author come to a phase where author need to balance the system by getting the same computing speed at decreased energy consumption. In this paper author proposed different ideas towards green calculating method. *Bhanu Priya et al.,[13]* gave a cloud computing metrics to make the cloud green in standings of energy efficiency, different models of energy has been discussed so that to decrease the consumption of power along with emission of carbon-dioxide to make cloud more green as compared to earlier. This survey takes three major-factors are taken under-consideration; any cloud might be green by succeeding these specific factors, 1st cause to create cloud greener is virtualization, Second, one is Work load movement and third is software mechanization, some of the additional factors are also deliberated like pay-per-use as well as self-service that is shown as a key for reduction of energy consumption. *Kaur and Singh et al.,[14]* performed the dissimilar trials in the field of energy in cloud computing, a model is suggested by author to calculate the energy misused by manufacturing various gases in environment. The proposed-model comprises several fields Data, Record, Investigation, Put on detailed guard, restrain together with the virtualization-concept in green-cloud to brand it energy-efficient as well as for healthy atmosphere. *Divya Doraya, [15]* the author stated that cloud clients are increasing day-by-day that has constrained the cloud-service-provider towards opening more data-centres for the purpose of hosting their services more efficiently. The increasing demand of Cloud-computing has also augmented the consumption of energy of cloud-data centres vividly. High consumption of energy not just only upsurges the operational-cost however it also decreases the profit-margin of cloud-service-providers and it also affects the whole environment through its carbon-emission. So as to make cloud-computing an eco-friendly technology, some energy-efficient solutions are mandatory. Hence, this paper is talking about the motivation along with several driving forces required for green-computing. It also deliberates the important problems faced in green-cloud-computing.

The below *table no. 1* described that the summary of schedulers like Grid computing, DVFS enables scheduling and Power Aware Scheduling etc.

Table no: 1 Summary of Schedulers

Schedulers	Cloud Computing	Grid Computing	Static Scheduling	Green Aspect	Dynamic Scheduling	Network Awareness	Algorithm Used
Grid Scheduling	F	T	F	T	F	F	Not found
Green Scheduler	T	F	T	F	T	F	History prediction algorithm on/off algorithm task schedule algorithm
DVFS enables Scheduling	T	F	T	F	F	F	Not Found
Thermal Aware Scheduling	T	F		F	F	F	Not Found
Power Aware Scheduling	T	F	T	F	F	F	Greedy Based algorithm
Central Scheduler	F	T	F	F	T	T	Simulated Annealing Algorithm
Migration Scheduler	F	T	F	F	T	T	Not Found

Table no. 2 Scheduling Example [16]

I/O Bound Processes	Arrival Time	Burst Time	CPU bound Processes	Arrival Time	Burst Time
P1	0	8	C1	0	20
P2	0	9	C2	0	25
P3	0	5	C3	30	30
P4	21	6	C4	35	35
P5	25	7	C5	40	15

In given example we have considered 5 processes where 6 are 6 I/O bound and 5 are CPU bound processes shown in *table 2*. Assume all time measures are in seconds.

2.1 Analysis of Mean Power

The busy cycle is a dated from the end of a busy period to the end to the [17] no tasks next busy period. If there are arriving at $node_j$ during the idle state, the time period of the busy cycle t_j^{recy} of $node_j$ consists of the idle time t_j^{Lesur} , the immediately. Following sleep time t_j^{slep}, the recovering time $t_j^{recover}$, an dteh running time interval t_j^{run}.

Therefore, T_j^{lesur} follows the conditional distribution of a task arriving interval $U_j < T_j^{idl}$, Result , the mean duration of idle state of the compute node is as follows.

$E(t_j^{lesur}) = T_j^{idl}\ e^{-}\lambda jT_j^{idl} + (1-e-\lambda jT_j^{idl})\ E\ (Vj|Vj < T_j^{idl})$ ……………….(i)

Where Vi follows the exponential distribution with parameters λj , under the condition of Vj is as follows;

$$GV_j(K)=\begin{Bmatrix} 0 & t \le 0; \\ 1-e-\lambda j\,t & 0 < t < \text{Tjidl}; \\ 1, & t > \text{Tjidl} \end{Bmatrix} \qquad \text{(ii)}$$

3. SIMULATION TECHNIQUES

3.1 Multilevel Feedback Queue Scheduling Algorithm

Multilevel feedback queue scheduling: In multilevel feedback queue scheduling also ready queue is divided into multiple sub queues but in multilevel feedback queue scheduling technique processes can move in between multiple queues.

Multiple FIFO queues are used and the action is as surveys:

- A new development is inserted at the end (tail) of the top-level FIFO queue [18].
- At some stage the process extents the head of the queue and is assigned the CPU.
- If the process is complete within the time quantum of the given column, it leaves the system.
- If the method voluntarily abandons control of the CPU, it leaves the queuing network, and when the process develops ready again it is inserted at the tail of the same queue which it abandoned earlier.

If the process uses all the significant time, it is pre-empted and introduced at the end of the next lower level queue. This next lower level train will have a time quantum which is supplementary than that of the previous higher level queue. This

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scheme will endure until the process finalizes or it reaches the base level queue. At the base level queue the processes circulate in round robin way until it comprehensive and leave the arrangement. Processes in the base level queue can also be scheduled on a first come first served basis. Optionally, if a process blocks for I/O, it is 'promoted' one level, and positioned at the end of the next-higher file. This allows I/O bound processes to be favored by the scheduler and allows processes to 'escape' the base level queue.

3.2 Adaptive Min-Min Scheduling Algorithm

The approval of the Internet and the handiness of powerful processers and high-speed networks as low-cost commodity mechanisms make it possible to construct large-scale high performance Grid computing systems.

These technical chances enable the distribution, selection, and accumulation of geographically disseminated heterogeneous resources for solving large-scale problems in science, engineering, and commerce. To achieve the promising potentials of tremendous distributed properties, effective and efficient scheduling algorithms are fundamentally important. The preparation problematic deals with the management and allocation of resources so as to efficiently execute the users' applications.

The existing heuristic scheduling can be classified into two categories:

- Online mode and [19]
- Batch mode.

Online mode scheduling diagrams a task to some calculating nodes as soon as it attains at the scheduler. Batch mode scheduling. Suggests that the task is not mapped to the nodes as it reaches. Instead, the tasks are composed in a set that is inspected for mapping at a prescheduled time called a mapping event. Our algorithm refers to the batch mode scheduling.
The overall structure of the algorithm is shown as follows

Algo 1*: *General Adaptive Scheduling Algorithm
Input: Task Set T
    Cluster Node set N
Output: Task Node Mapping

1) While there are tasks to schedule
2) For each Tj ϵ T
3) For each m j ϵ N
4) Calculate CTij = FTij +Aij
5) End for
6) Calculate metric = ej (CTij, CT ij…)
7) End for
8) Select best metric match
(e,n) = e2(metric 1,metric 2,…)
9) Calculate minimum CTt,n
10) Schedule task t and n
11) End While

The scheduling algorithm iteratively allocates tasks to mainframes by computing their expected Minimum Completion Time. For each task, this is complete by at first hesitantly scheduling it to each node (line3) and then resembling the task's assumption time on each node (line 4). Also, for each task, a metric function "*f*1" is computed over all expected completion times (line 6). Then the task/node pair with the best metric match *(t,n)* is selected by using collection function "*f*2" (line 8). After that, the MCT of this task/node pair is calculated (line 9) and the task *t* is allocated to the node *n* (line 10). The procedure is repeated till all the tasks have been arranged (line 1 and line 11).

From the description given above we see that the previous adaptive scheduling algorithms do not take energy consumption into consideration. We propose a novel energy-aware scheduling algorithm EAMM based on the general adaptive algorithm. It is shown as follows:

Algo 2*: *Adaptive Min-Min Algorithm

Input: Task set T

    Cluster Node set N

Output: Task –Node Mapping

1) While there are tasks to schedule
2) For each Ti ϵ T
3) For each nj ϵ N
4) Get power-state sj of node Nj
5) If Si ≠ 0
6) Modify the starting Time of Tj;
   Aij '= aij+wj.
7) En dif
8) Calculate CTij = ETij +Aij
9) End for
10) Calculate metric j = min{ CTj1, CTj2…..}
11) End for
12) Select best metric Match
    (t,n) =min{metric1, metric 2….}
13) Calculate minimum $Ct_{n,m}$
14) Schedule Task n on M
15) Modify Aij = Aij +ET $_{n,m}$, J ≠ n for each task j not schedule yet. And set each node to thepropoer power state according to the online strategy.
16) End while.[20]

3.3 Proposed Steps

a) ***Cloud Consumer:*** Cloud consumer are the user of cloud server. Cloud server interacts with millions of users at same time. Users send request to the server for processing and server return result accordingly.

b) ***Cloud Environment:*** Cloud environment which provides various services to the user. These are as IaaS, PaaS, and SaaS. These services are the modules of cloud server which provide data processing environment to their users. IaaS is the first layer of the system which provides way to access the other layer and facilities to the user.

c) ***Cloud service centre:*** Cloud service centre is responsible for check the user service area and their access bounds. User communicates with server for start processing with cloud server. It has various phases which used to check validation, process management, resource management, response handling etc. First layer of this process is Authentication and authorization.

d) ***Authentication and Authorization:*** This layer used to check user identity with cloud server. Due to various roles over cloud server cloud used third party authentication system to separate user data and access control over all the services.

e) ***Hybrid algorithm process centre:*** This process is sub-module which provides service to handle request by users and process them to provide results accordingly.

f) ***Cloud Datacentre and workload manager:*** It checks the user requests and resource allotment for the processes. This phase responsible for queue management and result calculation according to the user queries.

g) ***Job analyser:*** Job analyser extract job from user queue and check the validation for processing. It creates server side job slots to detect and trace the jobs at the time processing at cloud network.

h) ***Job Extraction:*** Job extraction used to extract and develop the requirements for process job. It gets the requirement from metadata and binds with the execution slot and passes it for processing in the cloud network.

i) ***Cloud Workload scheduler:*** It checks the network status and conditions over a cloud server. Data flow through this provides optimized results because server uses feedback technology to manage network status.

j) ***Cloud energy manager:*** It checks actual energy consumption of the tasks for give a priority to the jobs based on their energy consumption. It reduces waiting energy over a cloud server and optimizes response time also.

k) ***Resource scheduler:*** Resource scheduler collects all the information from the network and arranges the resources according to the job requirement. It also checks availability of the network and traffic over a network for speed optimization.

l) ***Resource manager:*** Here this layer process all the requirement provide by resource scheduler. This layer processes the scheduled processes by previous step.

m) ***IaaS Cloud:*** IaaS layer record all the execution and process setup over a cloud network because here all the information process and provide to user according to their allotted slot.

n) ***Task Spreading:*** All the Jobs spreading execute here. It spread all the jobs according to previous management and processes all the results over cloud network.

o) ***Stop:*** Clear the entire object which doesn't have reference in the memory for optimize the speed of network and generate response to user as result of their process.

4. RESULTS AND DISCUSSION

The figure below shows time consumption of Adaptive min-min algorithm with more than one tasks queue and having a system network for their execution. It is less time-consuming algorithm as compare to MSQ. The way it works with multiple queues is, it use optimal solution for execution over a network.

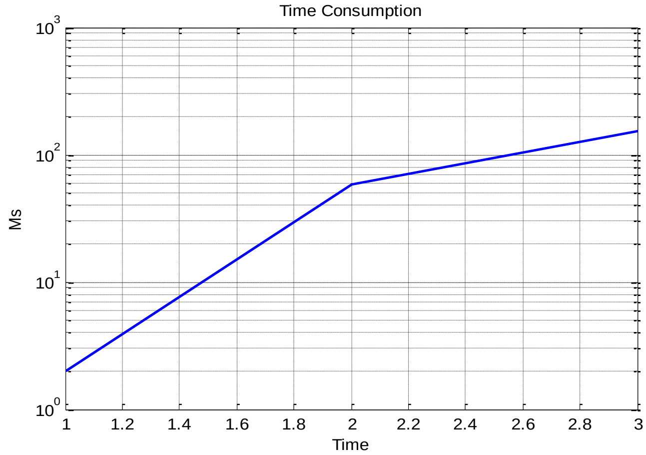

Figure 3: Time Consumption Adaptive Min-Min

The *figure* below shows Energy consumption of Adaptive min-min algorithm with more than one tasks queue and having a system network for their execution. It is more energy consuming algorithm as compare to MSQ because it doesn't have ability to work with multiple queues at a time

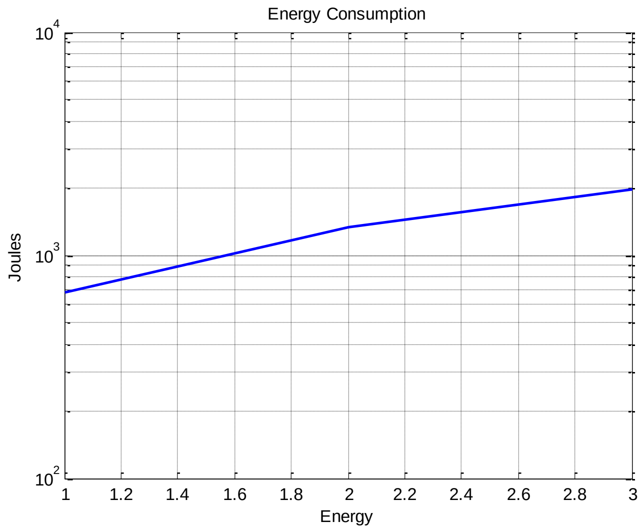

Figure 4: Energy Consumption Adaptive Min-Min

The figure below shows time consumption of Multi-Queue Scheduling algorithm with more than one tasks queue and having a system network for their execution. It is more time-consuming algorithm as compare to adaptive technique. The way it works with multiple queues is, it use optimal solution for execution over a network with little more time because the handling and pre-processing is time consuming process.

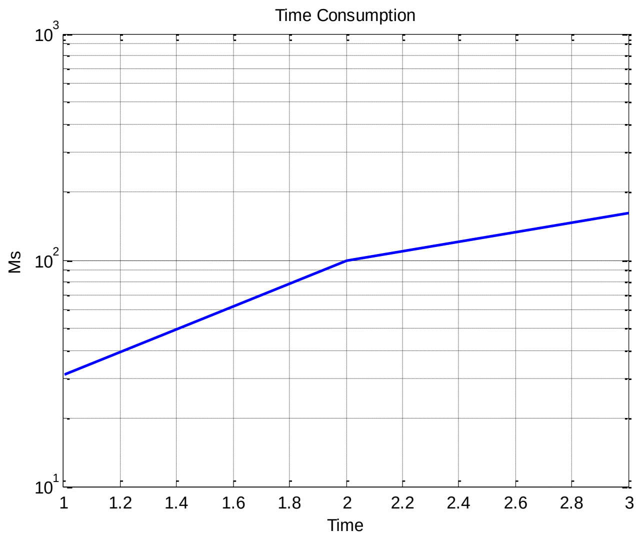

Figure 5: Time MQS (Multilevel queue feedback scheduling)

The *figure* below shows Energy consumption of Multi-Queue Scheduling algorithm with more than one tasks queue and having a system network for their execution. It is less Energy consuming algorithm as compare to adaptive technique. The way it works with multiple queue is it find a less cost solutions during pre-processing and execute them over a cloud network.

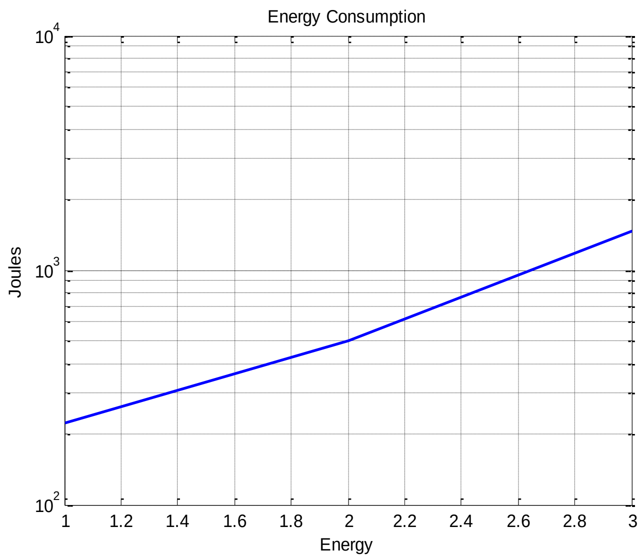

Figure 6: Energy MQS (Multilevel queue feedback scheduling)

The figure below shows time consumption of Hybrid Scheduling algorithm with more than one tasks queue and having a system network for their execution. It is less time consuming algorithm as compare to other existing technique. The way it works with Hybrid is, it is a combination of both adaptive and MQS scheduling algorithm. It generates optimal solution for execution and process all queues timely over a cloud server.

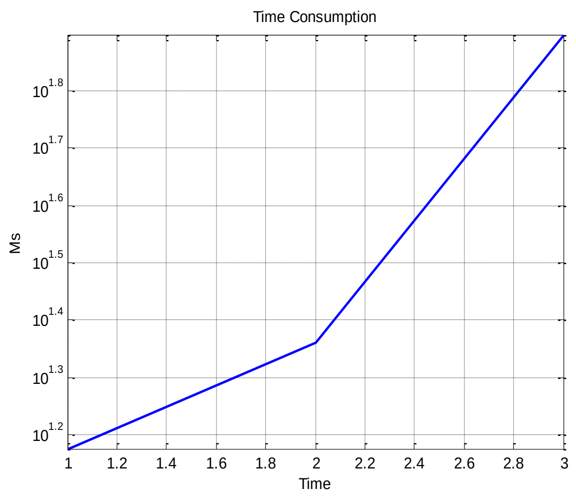

Figure 7: Time Proposed (Hybrid Approach)

The figure below shows time consumption of Hybrid Scheduling algorithm with more than one tasks queue and having a system network for their execution. It is less Energy consuming algorithm as compare to other existing technique. The way it works with Hybrid is, it is a combination of both adaptive and MQS scheduling algorithm. It generates optimal solution for execution and process all queues with less cost consumption over a cloud server.

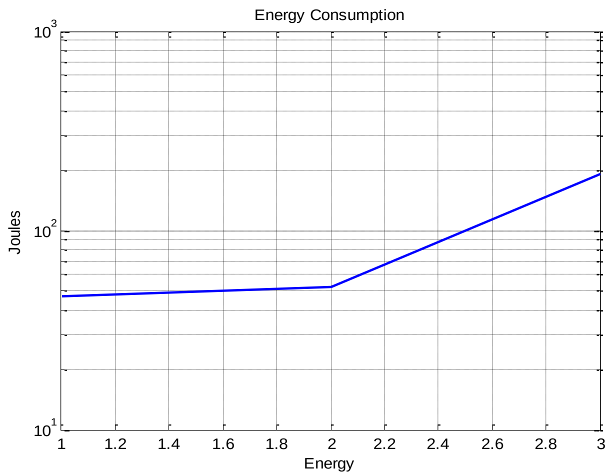

Figure 8: Energy proposed (Hybrid Approach)

The table below shows various execution tests have various existing approaches with our proposed approach. The table consist various tasks variations to test one algorithm in various possible conditions. In all cases the hybrid proposed approach consuming less time as compared to other existing technique as shown in the graph also.

Algo/tests	3	5	8	10
Adaptive min-min	152	214	310	496
Multi queue scheduling	162	238	314	524
Hybrid algorithm	96	170	255	389

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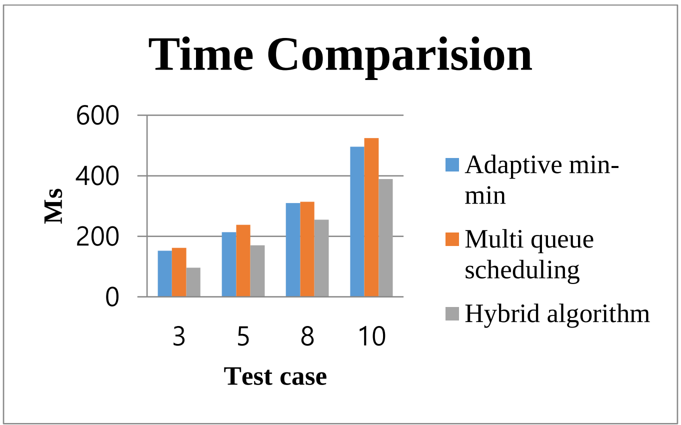

Figure 9: Time Comparison

The table below shows various execution tests have various existing approaches with our proposed approach. The table consist various tasks variations to test one algorithm in various possible conditions. In all cases the hybrid proposed approach consuming less energy as compared to other existing technique as shown in the graph also.

Algo/tests	3	5	8	10
Adaptive min-min	1974	2364	3550	4362
Multi queue scheduling	1462	1963	2957	3896
Hybrid algorithm	780	1285	2268	3254

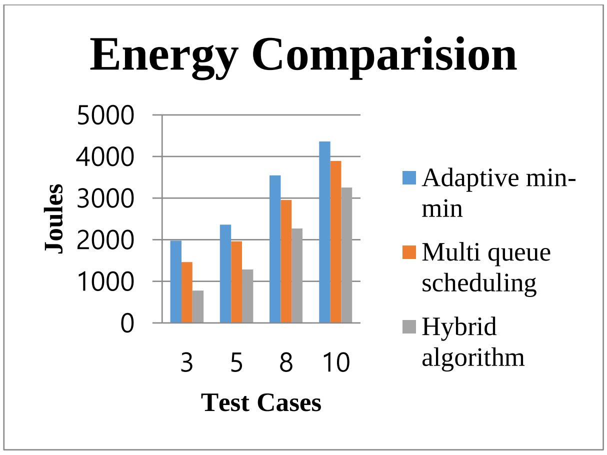

Figure 10: Energy Comparison

5. CONCLUSION

In this paper we addressed the problem of traditional cloud and the use of green cloud at the same time we enlighten the recent work which has been done in the field of green cloud computer for healthy and greener environment. We propose an energy-aware scheduling algorithm adaptive min-max algorithm and Multi level feedback queue scheduling to reduce energy consumption in heterogeneous clusters. Evolved from the conventional Min-Min algorithm, Adaptive min max algorithm is implemented with extra consideration to the energy consumption parameter. The performance of Adaptive min max algorithm and Multilevel Feedback queue scheduling in energy saving is evaluated by simulation experiments and compared with that of Conventional Min-Min algorithm. The empirical results show that Min-Min algorithm can significantly reduce energy consumption of large heterogeneous cluster systems with only a marginal degradation in makes pan performance. Furthermore, Min-Min algorithm also has good scalability under different scales of the cluster systems. Consequently, we gave a comparative study in the field of green cloud computing. There are many possible directions of future work. While in the paper we address the problem of efficient way to fetch the results from the cloud so all the features covered in the paper can be achieved.

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