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An Energy Proficiency Positioned Dynamic Threshold Approach to the Migration of Virtual Machines in DVS Empowered Green Cloud Data Centers

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Abstract— The furthermost eco-amicable challenge nowadays is ecumenical warming. Energy disaster conveys green computing. Dynamic voltage scaling (DVS) has been a crucial procedure in exploiting the hardware characteristics of cloud datacenters to preserve energy by lowering the supply voltage and operating frequency. The study presents modified power consumption can be reduced by live migration of the virtual machines (VM) as required and by switching off idle machines. So, proposed a dynamic threshold predicated approach DMM CPU utilization for host at data center. This consolidation will work on dynamic and capricious workload evading nonessential power consumption. It will meet energy efficiency requisite but would withal ascertain quality of accommodation to the utilizer by minimizing the Service Level Agreement(SLA) contravention. The proposed is a graphic implement CloudSim as its simulation engine and offers a facile-to-use utilizer interface, report generation features and engenderment of extensions in a plugin fashion. Dynamic consolidation of virtual machines (VMs) utilizing live migration and switching idle nodes to the slumber manner sanction Cloud providers to optimize resource custom and diminish Energy consumption.

Keywords: Dynamic Threshold, Dynamic Voltage Scaling, Dynamic Minimization of Migration, Live Migration, Service level agreement.

1. Summary

Cloud computing has emerged as a leading technology to provide computational accommodations on pay per utilization substructure. Data centers works as a backbone of these modern cloud computing technologies. Data centers are utilized in to host the cloud computing application and provide computational infrastructure. This results in low utilization of resources and sizably voluminous amount of puissance wastage. Power utilized in the operations of data centers results in very high operational cost and it damages the environment. Because of the high operation cost and damage to the environment organization are moving toward the green computing. Energy in efficiency in data centers is the idle power wasted when servers run at low utilization. Even at a very low load, such as 10% CPU utilization, the puissance consumed is over 50% of the peak power [1]. Consolidation thus sanctions amortizing the idle power costs more efficiently.Typically, a cloud application can be divided into one or more tasks executed in one or more containers (e.g., virtual machines (VMs)). At run time, schedulers are responsible for assigning tasks to machines. In today's authenticity, engenderment data centers such as Google's cloud backend often execute tremendous number (e.g., millions) of tasks on a quotidian substructure [2]. On the other hand, governmental agencies perpetuate to implement standards and regulations to promote energy-efficient (i.e., "Green") computing [4]. Incentivized by these observations, cutting down electricity cost has become a primary concern of today's data center operators.

2. Literature Evaluation

Lowering the energy utilization of data centers is a challenging and involute issue because computing applications increasingly more sizably voluminous servers and disks are needed to process them expeditious enough within the required duration. Green Cloud computing is envisioned to achieve not only the efficient processing and utilization of a computing infrastructure, but additionally to minimize energy consumption. To address this quandary and drive Green Cloud computing, data center resources need to be managed in an energy-efficient manner. Cloud resources need to be allocated not only to slake Quality of Accommodation (QoS) requisites designated by users via Service Level Agreement (SLAs), but withal to reduce energy utilization.

Table 1: Comparison Table of Pragmatic Evaluation

S. No	Authors	Mechanism	Energy Mgt	Techniques	Objective	Benefits
1	B. Khargharia *et al.*,	Dynamic Power Management Dynamic Voltage Scaling	Yes	✓ Autonomic power and performance management	✓ Power consumption is reaching unsustainable limits ✓ Reduced power consumption & cooling, improved density, reliability & compliance	✓ Coordinated architecture, ✓ Uncoordinated solution with five individual power management solutions
2	K. H. Kim, et al.,	Power-aware provisioning Algorithm	Yes	✓ Real-time service provision virtual machines	✓ Reducing power consumption ✓ Decrease operating costs, but also to improve the system reliability	✓ Power-Aware Provisioning ✓ Providing Real time Services
3	E. Seo, et al.,	DVS algorithm	Yes	✓ TSB (time slice based), a new DVS algorithm , ✓ DVS	✓ Reduced the side effect short-term execution ✓ Compared to results of 136% for CPU Speed	✓ TSB adjusts processor performance ✓ Match the performance demand.
4	K. Wu, et al.,	Interval-based DVS algorithms	Yes	✓ DVS, ✓ self-adaptive algorithm called SADVS	✓ Adjust the CPU speed in the following interval	✓ Energy consumption 0.02%-0.4% without time extension
5	D. K. Shin et al.,	Sim DVS Algorithm	Yes	✓ low-power design technique	✓ Incur higher system overheads, ✓ Degrading the overall energy efficiency	✓ Energy efficiency of the intra-task DVS algorithm and inter-task DVS algorithms
6	Y. Zhang, et al.,	Optimal procrastinating voltage scheduling (OP-DVS) Algorithm	Yes	Single-task and multi-task workloads	✓ Reduce 30% energy savings for single-task workloads and 74% for multi-task workloads	✓ Offline calculations ✓ worst-case execution, ✓ Online scheduling
7	C. H. Lee, et al.,	On-line dynamic voltage scaling Algorithm	Yes	✓ Dynamic voltage scaling (DVS) ✓ real-time scheduler	✓ Achieves great energy savings and outperforms the existing DVS	✓ Total computation requirement is higher than 40% ✓ Hardware characteristics of processors to reduce energy
8	J. Ahmed and C. Chakrabarti,	Dynamic task scheduling algorithm	Yes	✓ First phase (off-line) a battery-aware algorithm ✓ Second phase (on-line), Reassigns the voltage levels	✓ Maximize the residual charge and the battery voltage	✓ Maximize the residual charge and the battery voltage after the execution of tasks.
9	H. S. Jung, et al.,,	Dynamic thermal management (DTM) Markovian decision process (MDP) model	Yes	✓ Thermally-managed system ✓ Stochastic process model	✓ Effectiveness of the modeling framework	✓ Minimizing the energy cost ✓ Performance under a peak temperature
10	M. Mezmaza et al.,	Island parallel model Multi-start parallel model	Yes	✓ Heterogeneous computing systems (HCSs) ✓ Minimize the completion time (make span)	✓ Dynamic voltage scaling (DVS) to minimize energy consumption ✓ Completion time, the obtained schedules	✓ Minimizing the energy and cost
11	L. Chandnani and H. K. Kapoor,	Probabilistic model checker PRISM DBS and DES	Yes	✓ DVS-based power management policy for multiprocessor systems	✓ DBS model achieved 29.46% in theoretical, 8.75% in actual ✓ DES model 30% in theoretical, 11.9% in actual	✓ Aim is to optimize power consumption
12	Z. Goo, et al.,	Sensor placement algorithm Gaussian mixture model	Yes	✓ adaptive sensor placement Boundary estimation	✓ Real-time estimates of object distribution	✓ Characterize the mixture distribution of object locations

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3. Implementation

The two main approaches for energy efficiency of Cloud computing: Cloud Data center and Cloud networking.

3.1 Energy-Aware Data Centre Resource Allocation

Dynamic Threshold (DT) is based on the idea of setting an upper utilization threshold for hosts and placing VMs while keeping the total utilization of the CPU below this threshold. Dynamic Threshold (DT)[5]

- Minimization of Migrations (MM)
- Highest Potential Growth (HPG)
- Random Choice (RC)

3.2 Power Model

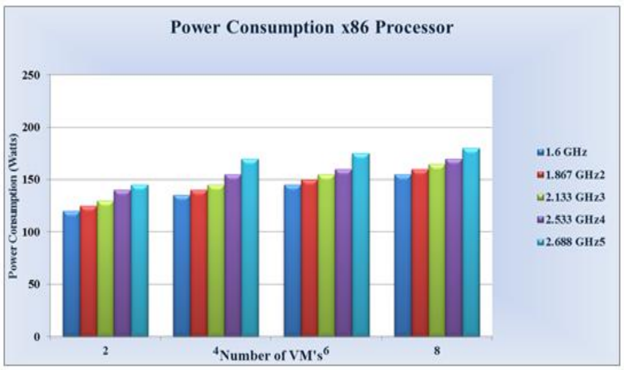

Figure2: Power Consumption Variation of X86 Processor

Total energy (E) consumption by a physical node can be defined as an integral of the power consumption function over a period of time (2).

Table 2: Dynamic Energy Power Model for Data Centers

Metric Description	Metric Formulation
Linear Power-To-Frequency Relationship	$p(u) = k * P_{max} + (1-k) * P_{max} * u$ (1)
CPU Utilization	$E \int_{t}^{\infty} P(u(t))$ (2)
Allocation Policies	$U_{VM} = \frac{\text{totalRequested(Mips)}}{\text{totalMips for that VM}}$ (4)

3.3 Allocation Policies

The selection of VM for migration is done to optimize the allocation. Here, we first calculated the CPU utilization of all VMs as shown below in (4):

4. Methodology

4.1 Green Cloud Model

Clouds aim to drive the design of the next generation data centers by architecting them as networks of virtual services (hardware, database, user-interface, application logic) so that users can access and deploy applications from anywhere in the world on demand at competitive costs depending on their QoS requirements. There are basically four main entities involved:

a) Consumers/Brokers

b) Green Resource Allocator

c) VMs

d) Physical Machines

4.2 Cloud Power Model

Power consumption by computing nodes in data centers is mostly determined by the CPU, memory, disk storage and network interfaces.

4.3 Energy-Aware Allocation Of Data Center Resources

Recent developments in virtualization have resulted in its proliferation across data centers. By supporting the movement of VMs between physical nodes, it enables dynamic migration of VMs according to the performance requirement.

Table 4: Data Center Broad Portrayal

Allocation Policy	Dynamic Threshold
Architecture	X86
Operating System	Linux
Hypervisor	Xen, Kvm
Scheduling Interval	30
Upper Threshold	0.8
Lower Threshold	0.2
Vm Migrations	Enabled
Monitoring Interval	180

Currently, resource allocation in a Cloud data center aims to provide high performance while meeting SLAs, without focusing on allocating VMs to minimize energy consumption. To explore both performance and energy efficiency, three crucial issues must be addressed. First, excessive power cycling of a server could reduce its reliability. Second, turning resources off in a dynamic environment is risky from the QoS perspective.it improves the performance and power. The Optimization of the Cloud Resources has to be utilized.

4.4 VM placement

The problem of VM allocation can be divided in two: the first part is the admission of new requests for VM provisioning and placing the VMs on hosts [6]

Algorithm 1: Improved Modified Best Fit Decreasing (IMBFD)

```
Input: hostList, vmList Output: allocation of VMs
vmList.sort DecreasingUtilization ()
foreach vm in vmList do
minPower←MAX
allocatedHost←NULL
foreach hosts in hostList do
if host has enough resource for vm then
power ←estimate Power (host, vm)
if power < minPower then
allocatedHost←host
minPower←power
if allocatedHost≠ NULL then
allocate vm to allocatedHost
return allocation
```

Figure4: Improved Modified Best Fit Decreasing

4.5 Minimization Of Migrations Algorithm

The Minimization of Migrations (MM) policy selects the minimum number of VMs needed to migrate from a host to lower the CPU utilization below the upper utilization threshold if the upper threshold is violated.

```
Algorithm Dynamic Minimization of Migrations (DMM)
Input: hostList Output: migrationList
foreach h in hostList do
vmList←h.getVmList ()
vmList.sortincreasingUtilization ()
hUtil←h.getUtil ()
bestFitUtil←min
while hUtil > THRESH_low do
foreach vm in vmList do
if vm.getUtil() > hUtil − THRESH_UP then
t←vm.getUtil () − hUtil + THRESH_UP
if t < bestFitUtil then
bestFitUtil←t
bestFitVm←vm
else
if bestFitUtil = min then
bestFitVm←vm
break
hUtil←hUtil − bestFitVm.getUtil ()
migrationList.add (bestFitVm)
vmList.remove (bestFitVm)
if hUtil < THRESH_LOW then
migrationList.add (h.getVmList ())
vmList.remove ()
```

Figure 5:Dynamic Minimization of Migration

In our modification sort all the VMs in the decreasing order of current CPU utilizations and allocate each VM to a host that provides the least increase of the power consumption caused by the allocation.[13]

5. Results And Discussions

The data center that comprises 1500 heterogeneous physical nodes.[12]Each node is modeled to have one CPU core with performance equivalent to 2000, 2500, 3000 or 3500 Million Instructions Per Second (MIPS), 16 GB of RAM, 10 GB/s network bandwidth and 1 TB of storage.

5.1 Performance Comparison

The experiment is done on Cloud Sim 3.0.1 by simulated and the data center properties as stated below:

Table5: Data Center Properties

Data Center Size	Hosts	Virtual Machines	Cloudlets
Small Data Centers	10	20	20
Medium Data Centers	100	200	200
Large Data Centers	1000	2000	2000

According to the Data Center create the Number of Hosts, Virtual Machines, Cloudlets can be created. The host Attributes are listed as RAM, Bandwidth, Storage, Max power, Static Power Percentage, VM Scheduling are the general setting of the Host.it Create according to the Constraints [14]

Table6: Host Attributes

Amount Of Hosts	Increase
RAM	40 GB
Bandwidth	10,000,00 MB
Storage	1,000,000 MB
Max Power	250Watt
Static Power Percent	0.7
Processing Elements	4
MIPS	2400
VM Scheduling	Time Shared, Space Shared
Power Model	Linear, Square root, Square, Cubic
RAM Provisioners	Simple
Bandwidth Provisioners	Simple
PE Provisioners	Simple

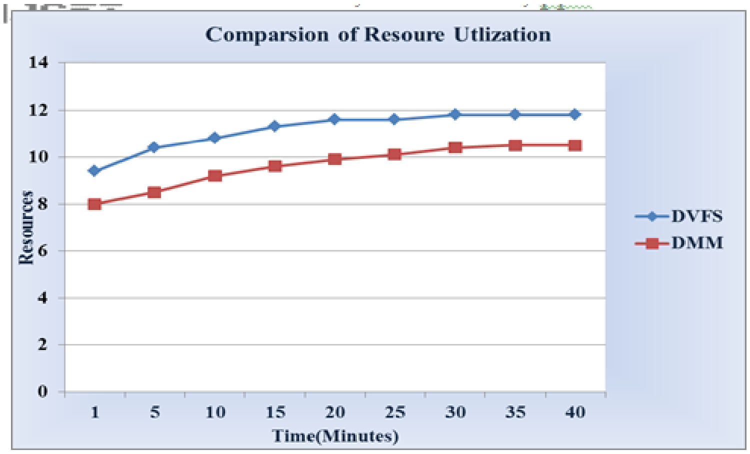

Figure 6: Comparison of resource utilization existing with proposed system

In figure 6 it shows the Comparison of resource utilization with existing and DMM as shown. It improves the performance and produce better results. Compare to the other power simulation methods DMM produce the maximum power utilization of the data centers.

The proposed framework reduces the resources, power, heat energy and reduce the operating cost too. The Efficient best fit Decreasing Algorithm.it Fit the Vm according to the Utilization and the DMM Algorithm based on Threshold value of 0.2 and 0.8 it monitors the power consumption these two algorithm combinable work and produce better results in power efficiency.

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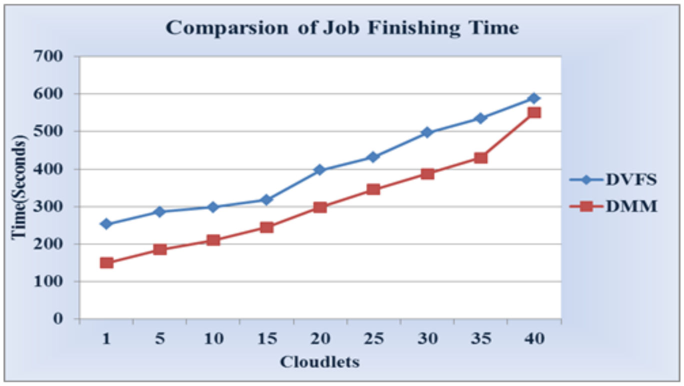

Figure 7: Comparison of powers utilization existing with proposed system

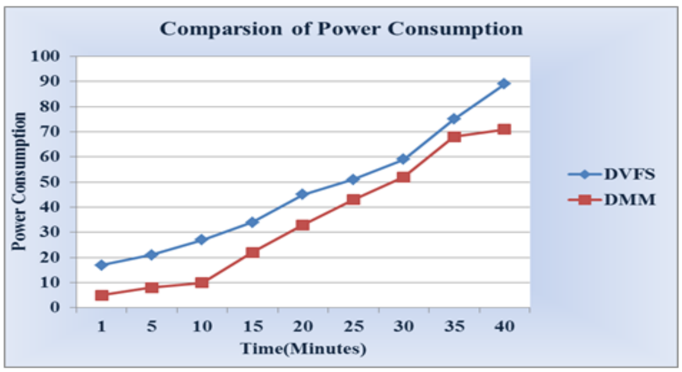

Figure 8: Comparison of energy utilization existing with proposed system

In figure 7 and 8 shows the result of power and energy comparison compare to DVFS and DMM (dynamic minimization of migration). It consumes low power utilization and energy so, that the system has to be effectively managed to consume less power.

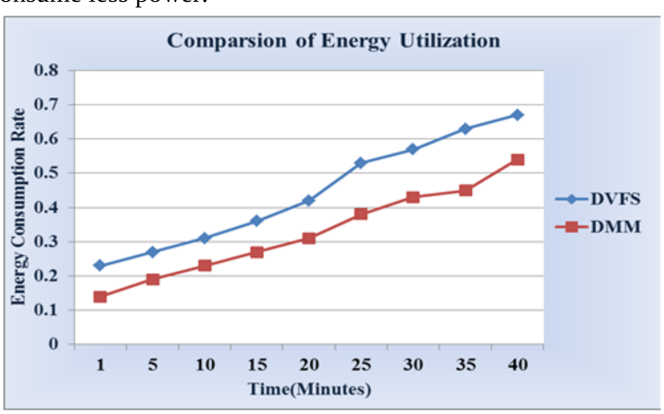

Figure 9: Comparison of cloud job finishing time existing with proposed system

In figure 9 shows that comparison between time taken for the each cloudlets and completed job shown in the diagram. In cloud data center, the allocation of virtual machines with multiple resources plays an important role in improving the energy efficiency and performance of cloud computing. It will reduce the energy consumption of the cloud data center.

Table7: General Simulation Parameters

Variables	Value	Remarks
Number_of_Hosts	100	
No of VMs	250	
VM Allocation Policy	Dynamic Minimization Migration (DMM)	Vary as per policy we call
VM Selection Policy	Less Migration Time (LMT)	Vary as per policy we call
Upper and Lower Threshold	0.2 – 0.8	Within the range it allocates the VM
RAM Utilization Threshold	0.8	
CPU Utilization Threshold	0.8	
Scheduling Interval	150s	2.5M
Simulation_Limit	3 hrs.	

Table8 :Simulation parameters

Parameter Name	Value
Simulation Time	30 Seconds
Simulation Interval Time	0.1 Sec
Dynamic Threshold	Upper Threshold, Lower Threshold
DVS	True
Data Center Starting Load	30%
Task Size	8500 Bytes
Task Output Size	250000 Bytes
Task Duration	1 Second
Server Computing Capacity	100000 MIPS

In the Proposed System Effectively Manage the power and Avoid the Violation and improve the Better Performance.[15] In the Proposed System Effectively Manage the power and Avoid the Violation and improve the Better Performance.[17] The simulation tables of our DMM approach evaluation is depicted in Fig. 6,7,8,9. We can see that parameters shown in table 7 and 8. The effective power consumption has reduced by DMM approach from 48% to 58% level.

6. CONCLUSION

The proposed a dynamic threshold based CPU utilization for the dynamic and unpredictable workload for the cloud. The algorithm has tried to reduce the power consumption which can be a small step towards Green technology. It also showed the cost difference with and without using migration policy. By providing quality of service with cost optimization both broker and end users will be benefited. This algorithm is been tested and simulated on with our results which clearly show that by increasing CPU utilization more work can be done.

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