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Efficient Energy Cloud Computing

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Abstract— In recent years, research has been conducted in the area of large systems models, especially Parllel systems, to analyze and understand their behavior. Simulators are now commonly used in this area and are becoming more complex. Most of them provide frameworks for simulating application scheduling in various Grid infrastructures, others are specifically developed for modeling networks, but only a few of them simulate energy-efficient algorithms. This article describes which tools need to be implemented in a simulator in order to support energy-aware experimentation. The emphasis is on DVFS simulation, from its implementation in the simulator CloudSim to the whole methodology adopted to validate its functioning. In addition, a scientific application is used as a use case in both experiments and simulations, where the close relationship between DVFS efficiency and hardware architecture is highlighted. We are show, How DVFS significance increase the utilization of Cloud.

Keywords— DPM, DVS, ADPS, DVFS, CLOUDSIM.

I. INTRODUCTION

Over the last few years, cloud computing services have become increasingly popular due to the evolving data centers and parallel computing paradigms. The notion of a cloud is typically defined as a pool of computer resources organized to provide a computing function as a utility. The major IT companies, such as Microsoft, Google, Amazon, and IBM, pioneered the field of cloud computing and keep increasing their offerings in data distribution and computational hosting [28]. The operation of large geographically distributed data centers requires considerable amount of energy that accounts for a large slice of the total operational costs for cloud data centers [6, 2]. Gartner group estimates energy consumptions to account for up to 10% of the current data center operational expenses (OPEX), and this estimate may rise to 50% in the next few years [10]. However, computing based energy consumption is not the only power-related portion of the OPEX bill. High power consumption generates heat and requires an accompanying cooling system that costs in a range of $2 to $5 million per year for classical data centers [3]. Failure to keep data center temperatures within operational ranges drastically decreases hardware reliability and may potentially violate the Service Level Agreement (SLA) with the customers. A major portion (over 70%) of the heat is generated by the data center infrastructure [2].

From the energy efficiency perspective, a cloud computing data center ar usually made public as a pool of computing and communication resources organized at intervals the because of transform the received power into computing or data transfer work to satisfy user demands. the first power saving resolution targeted on making the data center hard- ware components power economical. Technologies, like Dynamic Voltage and Fre-quency Scaling (DVFS), and Dynamic Power Management (DPM) were extensively studied and wide deployed. as a results of a similar techniques suppose power-down and power-methodologies, the efficiency of these techniques is at the simplest restricted[2,3].

In fact, the everyday load accounts only for unit of time of data center resources . this allows swing the rest of the seventieth of the resources into a sleep mode for several of the time. However, achieving the on prime of desires central coordination and energy-aware employment designing techniques. Typical energy-aware designing solutions strive to:(a) concentrate the utilization in associate extremely minimum set of the computing resources and (b) maximize the number of resource which can be place into sleep mode[4] .

II. RELATED WORK

Peng Rong , et.al have proposed an answer to minimizing energy consumption of a ADPS taking part in tasks with precedence constraints, at intervals the planned approach, dynamic power management and voltage scaling techniques unit of measurement combined to scale back the energy consumption of the C.P.U. and devices. the development drawback is developed as associate variety programming draw back. Next, a three-phase heuristic resolution, that integrates power management, task bobbing up with and task voltage assignment, is provided. Results show that the planned approach outperforms existing strategies by a mean of eighteen in terms of the system-wide energy savings. The goal of low-power vogue for powered physics is to increase the battery service life whereas meeting performance needs. Unless optimizations unit of measurement applied at altogether utterly completely different levels, the capabilities of future systems unit of measurement severely restricted by the load of the batteries needed for academic degree acceptable quantity of service. reducing power dissipation could be a goal even for non-portable devices since excessive power dissipation finishes up in exaggerated packaging and cooling prices. Dynamic power management (DPM) and dynamic voltage scaling (DVS) have each tried to be very effective techniques for reducing power dissipation in such systems. This paper addresses minimizing energy consumption of a ADPS subject area periodic time tasks with precedence constraints at intervals the planned approach Experimental results demonstrate potency of the planned approach.

Qi Zhang, et.al have proposed the next understanding of the challenges of cloud computing . Cloud computing has recently emerged as a replacement paradigm for hosting and delivering services over the net, the increase of cloud computing is apace ever-changing the scope of information technology, and ultimately changing the long-held promise of utility computing into a reality. However, despite the various blessings offered by cloud computing, this technologies aren\\\\\\\'t matured enough to know its full potential. several key challenges throughout this domain, additionally as automatic resource provisioning, energy management and security management, ar alone getting down to receive attention from the analysis community. Therefore, we have a tendency to tend to tend to believe there\\\\\\\'s still tremendous chance for researchers to form contributions throughout this field.

Andreas Berl1, et.al have proposed that energy potency is a lot of and a lot of vital for future knowledge and communication technologies (ICT). This paper has reviewed the potential impact of energy saving ways that within which for the management of integrated systems that embrace microcomputer systems and networks. we\'ve got a bent to tend to propose that cloud computing with virtualization as but forward to (i) establish the foremost sources of energy consumption, and additionally the vital trade-offs between performance, QoS and energy potency and (ii) give insight into the style among that energy savings area unit getting to be achieved in large-scale microcomputer services that integrate communication needs. specific plug-ins and energy-control centres for networked large-scale hardware and package area unit getting to be enforced that they\\\'re getting to have vital impact, including:(i) reducing the package and hardware connected energy price of single or federate knowledge centres that execute 'cloud' applications;(ii) rising load reconciliation so QoS and performance of single and federate knowledge centres;(iii) reducing energy consumption as a results of communications;(iv) saving GHG and gas emissions succeeding from knowledge centres and networks therefore on give computing power that\\\\\\\'s 'environment protecting/conserving'. Such enhancements will have more impact by reducing energy utilization for transportation and work by encouraging 'green' ICT-based good solutions for e-work, e-learning and good climate management for homes.

Andrew J. Younge, et.al have proposed a current framework is providing has economical inexperienced enhancements among a climbable Cloud computing vogue. practice power-aware programming techniques, variable resource management, live migration, and a token virtual machine vogue, overall system potency unit of measurement on the brink of be immensely improved throughout a data center primarily based Cloud with token performance overhead. To demonstrate the potential of our framework, new energy aware programming, VM system pictures, and image management elements that explore new that} during which among which to conserve power. found new that} during which among which several|to avoid wasting} uncountable large amounts of energy whereas minimally impacting performance. Future opportunities could explore a programming system that\\\\\\\'s each power-aware and in addition thermal-aware to maximise energy savings each from physical servers and additionally the cooling systems used. Such a hardware would collectively drive the need for higher knowledge center styles, each in server placements among racks and closed-loop cooling systems integrated into every rack.

Dzmitry Kliazovich , et.al have proposed a simulation technique for energy-aware cloud computing data centers. inexperienced Cloud is supposed to capture details of the energy consumed by data center elements but as packet-level communication patterns between them. The simulation results obtained of two-tier, three-tier, and three-tier high-speed data center architectures demonstrate connectedness and impact from the applying of varied power management schemes like voltage scaling or dynamic closure applied on the computing but as on the networking elements.at the end of the day work can target the machine extension adding hold network techniques and extra refinement of energy models utilised at intervals the simulated elements. On the recursive zero.5, the analysis unit of measurement progressing to be targeted on the event of varied employment consolidation and traffic aggregation techniques.

Rodrigo N. Calheiros , et.al have proposed CloudSim: a simulation toolkit that enables modeling and simulation of Cloud computing systems and application provisioning environments. The CloudSim toolkit supports each system and behavior modeling of Cloud system parts like information centers, virtual machines (VMs) and resource provisioning policies.It implements generic application provisioning techniques which may be extended with ease and restricted effort. Currently, it supports modeling and simulation of Cloud computing environments consisting of every single and inter-networked clouds . Moreover, it exposes custom interfaces for implementing policies and provisioning techniques for allocation of VMs at a lower place inter-networked Cloud computing eventualities. several researchers from organizations square measure using CloudSim in their investigation on Cloud resource provisioning and energy-efficient management of data center resources. Simulation-based approaches in evaluating Cloud computing systems and application behaviors give important advantages, as they allow Cloud developers: (i) to look at the performance of their provisioning and repair delivery policies terribly} terribly repeatable and manageable atmosphere freed from cost; and (ii) to notice the performance bottlenecks before real-world activity on business Clouds. As future work, fully completely different future directions of this work embrace incorporating: (i) employment models; (ii) models for information services like blob, SQL etc.; (iii) QoS observance capability at VM and Cloud level; and (iv) analysis models for public clouds to support economy-oriented resource provisioning studies. additional in Cloud computing environments, immeasurable the future work can investigate new models and techniques for allocation of services to applications reckoning on energy potency and expenditure of service suppliers.

Pinal Salot have proposed that in cloud, there\\\'s a high communication worth that stops task schedulers to be applied in massive scale distributed setting. Today, researchers commit to build job programming algorithms that ar compatible and applicable in Cloud Computing setting . Job programming is most vital task in cloud computing setting as a results of user ought to get of resources used based mostly upon time, so economical utilization of resources need to be vital and for that programming plays an enormous role and this paper finds out varied programming rule and problems associated with them in cloud computing.

Dr. Rahul Malhotra,et.al have proposed that cloud computing may even be a hot topic everywhere the globe presently, through that customers will access information and notebook computer power via an online browser. as a results of the adoption and activity of cloud computing increase, it\\\\\\\'s necessary to guage the performance of cloud environments. Modeling and simulation technologies area unit acceptable for evaluating performance and security problems. Cloud simulators area unit needed for cloud system testing to decrease the standard and separate quality issues. many cloud simulators area unit specifically developed for performance analysis of cloud computing environments and CloudSim may even be among the Cloud simulation application. CloudSim permits modeling, simulation, experimentation of cloud computing and application services. This paper initial defines CloudSim then explores it's all variants offered in CloudSim among the last, it Compares all CloudSim Variant with reference to networking, platforms and varied languages.

III. CLOUDSIM

CloudSim may be a new, general, and protractile simulation framework that enables modeling, simulation, and experimentation of rising Cloud computing infrastructures and application services. In Cloud Computing Case, The Simulations Tools like CloudSim offers or offers vital edges to the shoppers and suppliers. for purchasers, it\'s enable them to check their services in governable atmosphere with freed from value and to ascertain the performance before publication to the important clouds. in the meantime for suppliers, enable them to ascertain the forms of leasing in keeping with varied costs and cargo. additionally, this can cause optimize the resources access value with up the profits. while not these tools, each of the shoppers and suppliers should suppose general evaluations, or on try-and-error approaches, these approaches could cause inefficient services performance and scale back revenue generation. additionally, CloudSim helps researchers and industry-based developers to check the performance of a developed application service during a appropriate and simple to setup environment[4,9].

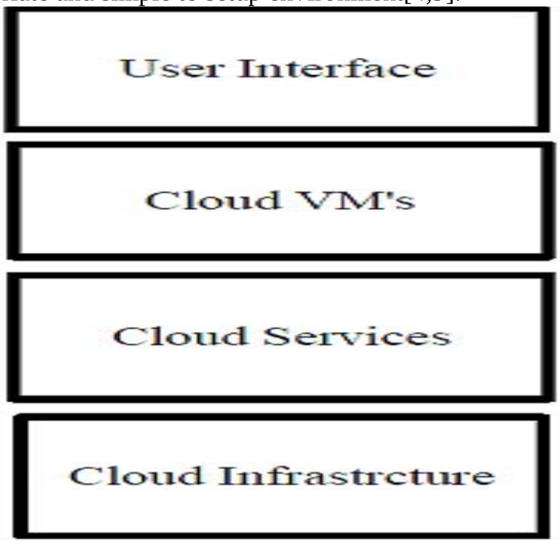


Fig. 1 CLOUDSIM COMPONENTS

IV. METHODOLOGY AND EXPERIMENTS

A. Methodology

The challenge is to perform an experiment that involves many frequency changes to test the behavior of DVFS, but also phases of constant load to use the power model over its entire range. In this scenario, the maximum CPU load value has been chosen to be 96% since it is enough to trigger frequency changes in dynamic DVFS modes.

1. progressive increase of CPU load from 0% to 96%.
2. a phase of stressed CPU load of 96%.
3. progressive decrease of CPU load from 96% to 50%.
4. peak CPU load to 80%.
5. progressive decrease of CPU load from 80% to 30%.
6. peak CPU load at 96%.
7. a phase of constant CPU load of 30%.

B. Experimental Framework

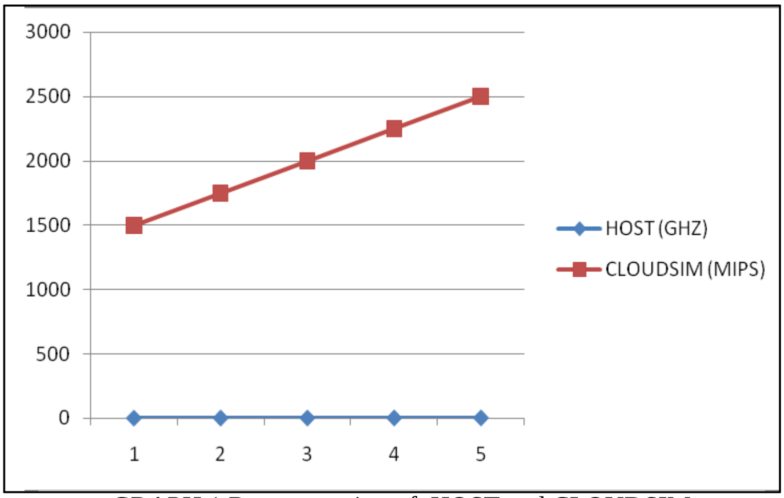
All experiments were performed on a standard host equipped with an Intel (R) Core i5Q6700@2.66 GHz with 4 GB of RAM memory, running Ubuntu 10.4 LTS (Linux kernel 2.6.32). All measurements of energy consumption were made with a wireless plogg2 power-meter which allows to measure and save energy consumption in realtime. One value can be obtained each second with a very high precision (>10À4 W).

C. Energy consumption calibration

The calculation of the energy consumption in the simulator, it is first necessary to know the frequency values (Table 1) allowed by the CPU of the host. In CloudSim, the frequency is expressed in MIPS, indeed, simulator frequencies have been calculated proportionally to the host HOST frequencies values. Then, power values given by the host at 0% and 100% of CPU utilization, called PCPUIdle and PCPUFull for each frequency (i.e., 2 Ã Nb_Freq measurements) are measured (Table 2).

HOST (GHZ)	CLOUDSIM (MIPS)
1.60	1498
1.867	1748
2.133	1997
2.40	2247
2.67	2500

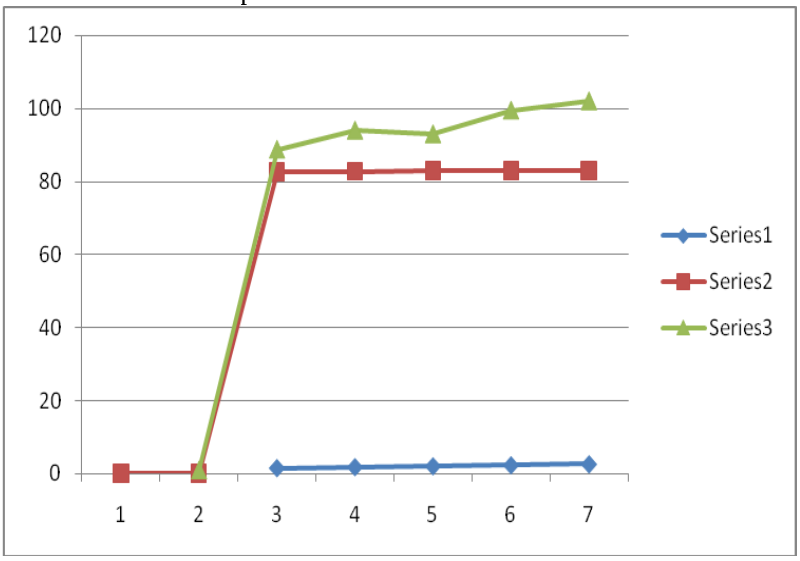
TABLE 1 Relationship between HOST and CLOUDSIM



GRAPH 1 Representation of HOST and CLOUDSIM

FREQUENCIES	CPU LOAD	
	0%	100%
1.6	82.7	88.77
1.867	82.85	94
2.113	83	93
2.4	83.1	99.45
2.67	83	102

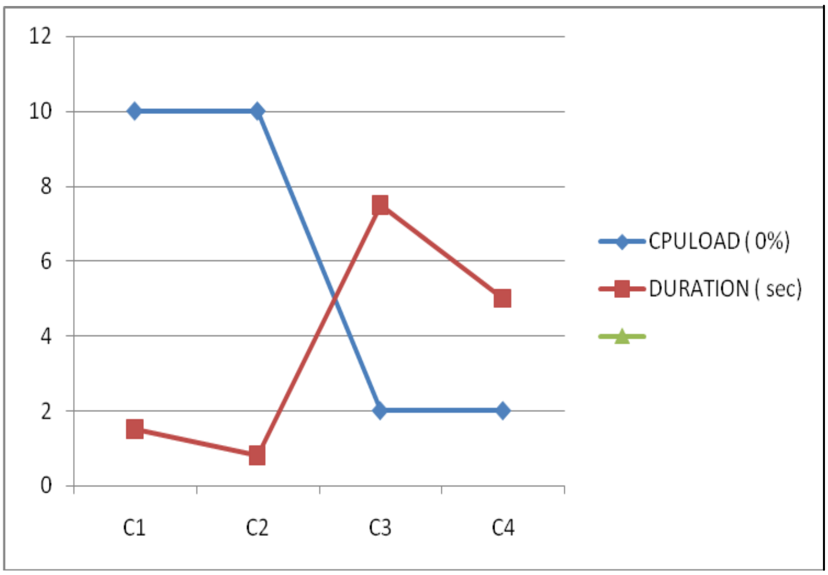
TABLE 2 Relatonship between FREQUENCIES and CPU LOAD



GRAPH 2 Representation of FREQUENCIES and CPULOAD

	CPULOAD (%)	DURATION (sec)
C1	10	1.5
C2	10	0.8
C3	2	7.5
C4	2	5

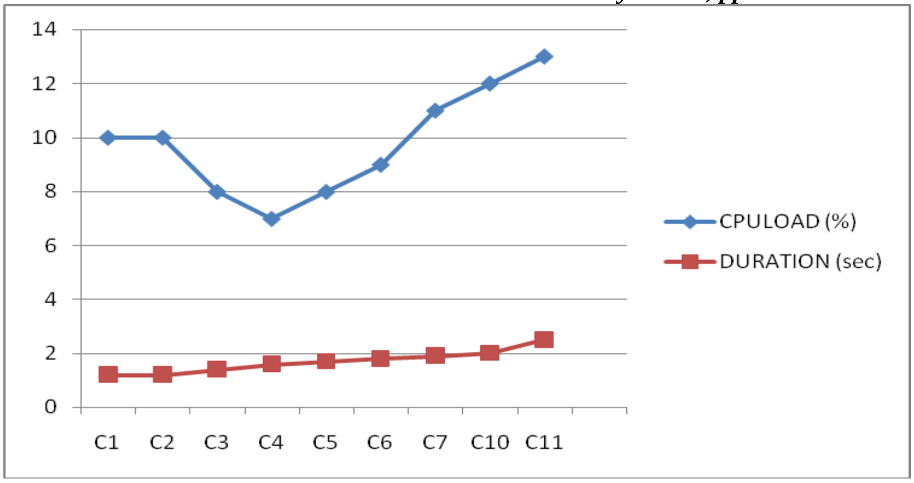
TABLE 3 Relationship between CPU LOAD and DURATION



GRAPH 3 Representation of CPULOAD and DURATION

	CPULOAD (%)	DURATION (sec)
C1	10	1.2
C2	10	1.2
C3	8	1.4
C4	7	1.6
C5	8	1.7
C6	9	1.8
C7	11	1.9
C10	12	2
C11	13	2.5

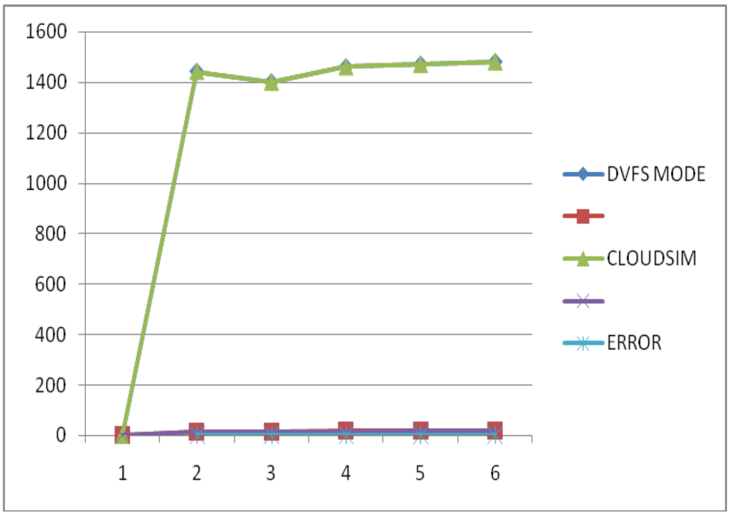
TABLE 4 Relationship between CPU LOAD and DURATION



GRAPH 4 Representation of CPULOAD and DURATION

DVFS MODE		CLOUDSIM		ERROR
DURATION	ENERGY	DURATION	ENERGY	
1442	15	1442	15.45	0.45
1400	14.5	1400	15.34	0.84
1460	16	1460	15.75	0.25
1470	17	1470	18	1
1480	18	1480	18.5	0.5

TABLE 5 Relationship between DVFS MODE and CLOUDSIM



GRAPH 5 Representation of DVFS MODE and CLOUDSIM

D. Diagram

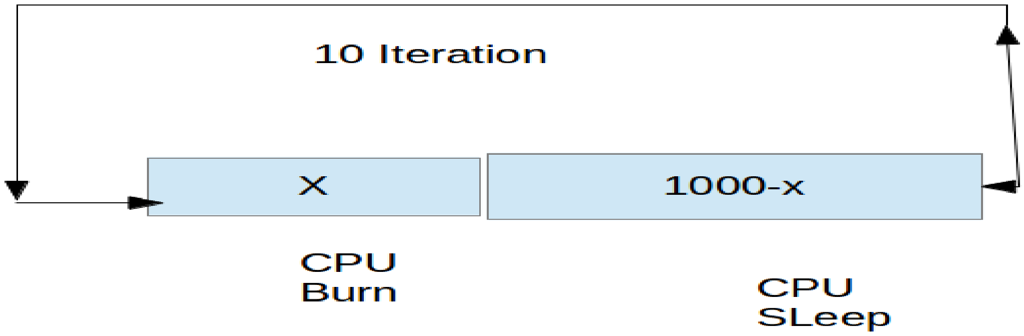


FIG 2 RELATION BETWEEN CPU burn and CPU sleep

To run this scenario on the host HOST, a test application was implemented in C language. The desired average load is obtained by performing a loop, illustrated in (DIagra no.)where each iteration is composed of a calculation period and a sleep period.When DVFS is enabled, the CPU load is checked every sampling rate (10 ms). To be sure that the decision of the DVFS governor is taken directly linked with the CPU load generated by the computation loop, each time iteration of the loop must be exactly equal to the interval sampling rate.

V. CONCLUSIONS

The purpose of this article was to provide an overview of the available energy-aware simulators and to describe the necessary tools required in a simulator to obtain accurate simulations in terms of energy consumption. After describing how both DVFS and DAGs have been incorporated in CloudSim, the methodology applied to evaluate the DVFS accuracy was ex- plained in details in Section 5 and showed a worst energy consumption percentage error smaller than

2%, as compared to a real host, using a simple test bench application. This section highlighted the importance of the calibration phase, which demands a good knowledge of application, middleware, and hardware.
The evaluation section gives interesting conclusions about DVFS behavior, which was found to be closely linked with the internal architecture of the hosts and application functioning. Indeed, concerning the impact of the used architecture, intrinsic application behavior that impacts DVFS was also explained, showing that the pooling time also points out the lack of efficiency of the OnDemand mode in this situation. In DAG simulations, the aim was to show the efficiency of slowing down non-critical tasks regarding their slack-time by using different DVFS modes. Results compared the energy consumption obtained using optimal fixed frequencies in Performance in which DVFS is used, otherwise it may not necessarily always be efficient in terms of energy saving.

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