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Joulemeter: Power Measurement for Virtual Machine in Private Cloud Computing

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Abstract: In private cloud environment power measuring and their management is most important for cloud service providers because of virtual machines how much power consumed cannot measure purely hardware. Microsoft Co-operation provides a glorious tool Joulemeter [18] to measure how much energy/power consumed by virtual machine. In this paper we discussed and elaborate how much energy required virtual machine in private cloud environments.

Keywords: VM, VMs, Energy, Host, Guest.

I. INTRODUCTION

Google engineers say a radiant sentence about cloud, maintains thousands of servers, warned that if power consumption continues to increase, power cost can easily overtake hardware cost by a large margin [1]. The Joulemeter1.2 [18] project is developing methods to improve energy efficiency of computing devices [5, 7, 13].

It provides tool to measure energy usage by virtual machines VMs. Joulemeter1.2 [18] is used in data enters, cloud environments improve power provisioning costs [1, 7].

In office, Institutes, Universities environment computers, monitors account for highest energy consumption after lighting. Power dissipation is also a major concern in portable battery operated devices that have rapidly increased [7].

Green computing is new inclination of Cloud computing and need of Green Computing. It is very clear that hardware power measuring device not connected to virtual machines to measure their power consumed in private cloud environment.

II. RELATED WORK

In this section, we refer many methods, devices, how to measured virtual machine call Guest to power consumed which is running on physical machine Hosts.

Kansal et. al [13] proposed a Joulemeter for measurement of consumed power of virtual machine as per how much time required in particular contest, states virtual machine power metering and provisioning architecture i.e. Joulemeter measure power of virtual machines per second in watt [9, 10, 11, 19].

Xiong et. al [2] introduce energy efficient data intensive in distributed computing environments.

Stoess et.al [8, 24] state Joule meter does not require any additional instrument of application workloads or operating systems within in virtual machines.

Kozyrakis et. al [5] proposed server engineering insights for large scale online services.

Srikantaiah et. al [6] discussed energy aware Consolidation for Cloud Computing.

Deore S., Patil A. [9] proposed systematic review of energy efficient scheduling techniques in which compare three scheduling methods which is better scheduling in energy efficient manner allocation of VMs as per request of consumer in that we Joulemerer1.2 [18] is used for measure energy [9, 10, 11, 19].

Deore S. , Patil A. [10] proposed Energy Efficient Scheduling Schemes for virtual machines in cloud computing call EESS migration, clone, pause, resume basic concept is introduce using minimum load distribution in private cloud environments by using Julimeter1.2 [18] to measure energy of VM [9, 10, 11, 19].

Deore S. , Patil A. [11] introduce Energy Efficient and allocation scheme EESAS for virtual machines in cloud environments, distribute total workload on minimum number of Hots that is physical machine by using Julimeter1.2 [18] to measure energy [9, 10, 11, 19].

Deore S. [19] proposed comparison between energy efficient scheduling scheme and energy efficient scheduling and allocation scheme which is better, in that paper they use Joulemeter1.2 [18] for measurement of power consumption [9, 10, 11, 19].

Jiandun Li et. al [3, 4] used WattsUp power meter and Energy-aware heuristic algorithm is used Voltech PM3000 ACE power analyzer both are hardware device as our experience when we take power, energy reading, these instruments do not get exact measurement of power, energy of VMs [9, 10, 11, 19].

III. JOULEMETER ARCHITECTURE

An architectural block diagram [13, 15] of the Joulemeter 1.2 [18] VM energy metering system is shown in below Figure 1. The block labelled workload represents the set of VMs hosted on the server. The system resource and power tracing module reads the full system CPU, disk, and power usage [13, 15].

The VM resource tracing module uses hypervisor counters to track individual VM resource usage. The base model training module implements the learning approach and the model refinement block implements the learning method. The output of base model training and previously learned

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VM models are used to decrease the number of unknowns in regression when a novel VM model is being learned [13, 15].

The energy calculation block uses the resource tracing data and model parameters in VM energy usage. The system is executed using Windows Server 2008 R2 Hyper-V but the concepts enlarge to other hypervisors as well [13, 15].

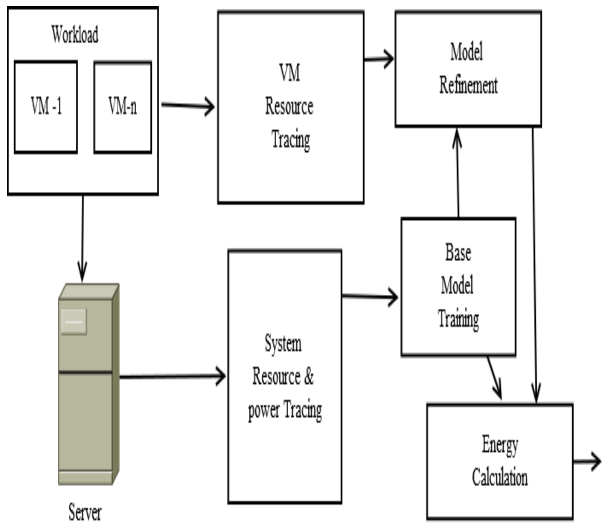

Fig.1 Architecture of Joulemeter

When we use joulemeter1.2 [18] for measuring power of virtual machines VMs then it gives such type of results

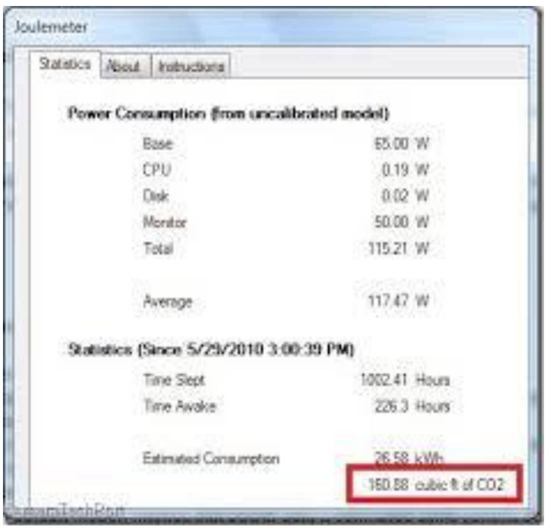

Fig.2 Energy measurement result window Joulemeter

IV. MEASUREMENT OF ENERGY OF VIRTUAL MACHINES (VM_S) THROUGH JOULEMETER1.2

We design EESS for VMs before in our privious we observe energy consumption of VMs through joulemeter1.2 [18] by applying simple SaaS, PaaS applications such as Games or Entertainment, e-Learning, OpenMPI based applications, Grids etc. such types of jobs and calculate energy usage of VMs in cloud environments then following Table1 show energy consumption by virtual machines [15].

We construct below table using joulemeter1.2 [18]. It generated data saved in comma separated values format that can be opened in Microsoft Excel for easy plotting, or viewed in any text editor as shown in Table II.

First column contain TmeStamp in millisecond. Microsoft Windows TimeStamp is different than Unix called Campell Scientific Data loggers store date, time, and current year see the first column and first row, first element is 6.35E+13 equals to one second. Second column of Table II contain total machine power required in one second in watt (W). Third column contain CPU power consumption in watt (W). Fourth column contain Monitor power consumption in watt. Fourth and fifth is for Disk and base power consumption [13, 15, 18].

The last column is application i.e Virtual Box [12] power consumption in one second in watt (W). This application reading is important for our EESS design [10] [11, 15].

We observe a keen observation of energy measurement in virtual machine using Figure 3 and 4.

Figure 3 is comparison of energy (J) usage of virtual machines in different states and Figure 4 is comparison of power (W) base of virtual machine in different states, conversion of power into energy using fallowing equations through theory of physics [14, 15].

E=Energy in Joule, P=Power in Watt, T= Time in second and N=number of VM, so we can write fallowing expression

$$E, P \propto N \propto T \qquad (I)$$

Again, we convert power into energy using physics conversation Physics (2007)

$$E_J = P_W \times T_S \qquad (II)$$

We bring to a close that avoid PowerOFF, PowerON of virtual machines, apply migration, clone, and pause, resume save to energy. VirtualBox3.1 [12] support all these features, using peak migration of VMs from one Host to another, for workload distribution, single virtual machine on running state and perform job i.e. such as game playing VM required energy 420J, more than one VM running at a time energy required in terms of quadruple, virtual machine PowerON state usage maximum energy approximately 1848J, VM PowerOFF energy required 564 J, VM in pause or resume state energy required 0J, VM running without job then it required some amount of energy so better way pause it and again required then resume it [10, 11, 15].

V. EXPERIMENTAL RESULT

We present series of experiments to exemplify the outcome of EESS discussed in previous paper. The test bed is composed on 4 personal computers.

Each host contain 4 VMs, Host1 acts as a scheduler, calculated conserve energy (E) in Joule (J), total time (T), power (W) , number of VM N, number of leases L, VM request from consumer J, j, workload is homogeneous [10, 11, 15].

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TABLE I Energy Measurement for VMs

States of Virtual machine (VM)	Time in S	Energy in J	Power in W
4 VMs running at a time	60	1464	24.4
3 VMs running at a time	60	972	16.2
2 VMs running at a time	60	552	9.2
1 VM running at a time	60	420	7
0 VM running at a time	60	0	0
1 VM power down	60	564	9.4
2 VMs power down at a time	60	1704	28.4
3 VMs power down at a time	60	2538	42.3
4 VMs power down at a time	60	3408	56.8
1 VM pause	60	84	1.4
1 VM resume	60	114	1.9
1 VM Teleport-In state	60	378	6.3
1 VM PowerON	60	1848	30.8

TABLE II Data generated by Joulemeter 1.2

TimeStamp (ms)	Power (W)	CPU (W)	Monitor (W)	Disk (W)	Base (W)	Application (W)
6.35E+13	11.8	5.9	-0.1	0	6	0.4
6.35E+13	13.3	7.3	-0.1	0	6	0.4
6.35E+13	8.9	3	-0.1	0	6	0.6
6.35E+13	11.6	5.7	-0.1	0	6	0.4

We observe that keep away from PowerOFF, PowerON of VMs, apply migration, clone, and pause, resume of VM capability to save maximum amount of energy. VirtualBox3.1 [12] support all these features, using peak migration of VMs from one Host to another, for workload distribution, single virtual machine on running state and perform job i.e. such as if we run different application such as Cricket game playing VM required energy 459J, more than one VMs running at a time energy required in terms of quadruple, VM PowerON state usage maximum energy just about 1930J, VM PowerOFF energy essential 631J, VM in pause or resume state energy required 0J, VM running without workload then it required some amount of power so better way pause it and again required then resume it [10, 11, 15]. Mainly number of Virtual machines VMs required as per number of Host required that we proposed in our previous work [9, 10, 11, 15, 19]. Number of VMs are increased then its consume energy also increased so we state that

$E, P \propto N(VMs$ III

VI. CONCLUSION

From the experimental result show above, it has been proved that energy (E/P) required for virtual machine is directly propositional to number (N) of virtual machines. Microsoft Co-operation provides glorious tool Joulemeter 1.2 [18] to measure how much energy consumed by virtual machine in particular timestamp. It is very useful tool for schedule number of VMs in minimum power requirement. Cloud service providers need of scheduling schemes as well as Joulemeter1.2 [18] for conserving more energy E and consumer satisfaction in cloud service providing.

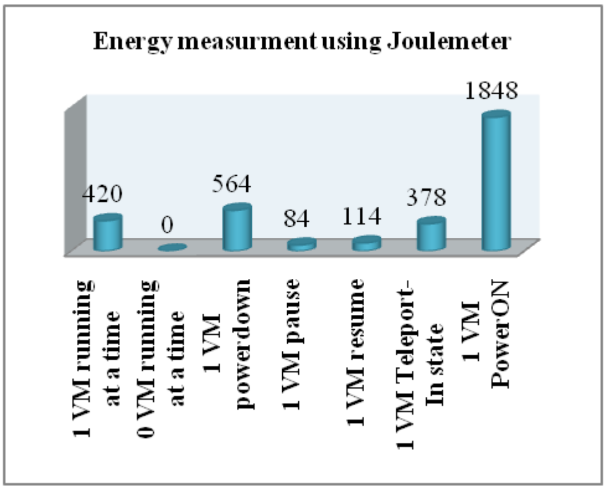

Fig 3 Energy measurement by Joulemeter

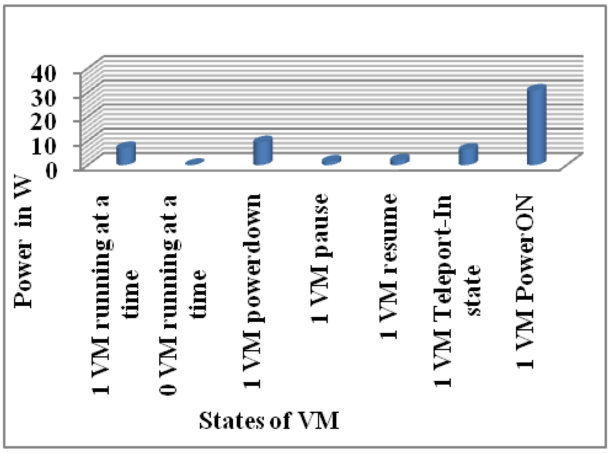

Fig 4 Power measurement by Joulemeter

REFERENCES

[1] Susane Albers (2010)," Energy efficient algorithms", Communication of ACM, vol.53 No.5, pp.86-96.
[2] Xiong Weiwei, Aman Kansal (2011), "Energy Effcient Data Intensive Distributed Computing, in IEEE Data Engineering (Special Issue on energy Aware Big Data Processing), IEEE computer Society.
[3] Jiandun Li, Junjie Peng, Wu Zhang (2011),"An Energy-efficient Scheduling Approach Based on Private Clouds", Journal of Information & Computational Science, volume 8, Number 4, pp.716-724.
[4] Jiandun Li, Junjie Peng, Wu Zhang (2011), "A Scheduling Algorithm for Private Clouds", Journal of Convergence Information Technology, Volume 6, Number 7, pp.1-9.

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[5] Kozyrakis Christos, Aman Kansal, Sriram Sanker, and Kushagra Vaid (2010), “Server Engineering Insights for Large-Scale online Services”, in IEEE Micro, IEEE.
[6] Srikantaiah Shekhar, Aman Kansal, Feng Zhao (2008), “Energy Aware Consolidation for Cloud Computing” , in USENIX Hotmeter’08: Workshop on power Aware Computing and System at OSDI, USENIX.
[7] D.Nurmi, R.Wolski, C.Grzgorczyk (2009), “The eculyptus open-source cloud-computing system”, In Proc. Of CCGRID’09, pp.124-131.
[8] Stoess Jan, Christian Lang, Frank Bellosa (2007),”Energy management for hypervisor-based virtual machines”, in proceedings of the 2007 USENIX Annual Technical Conference (USENIX ‘07), pp.1-14.
[9] Shailesh Deore, A.N. Patil (2012),”Systematic Review of Energy-Efficient Scheduling Techniques in Cloud Computing”, International Journal of Computer Applications, volume 52, number 15.
[10] Shailesh Deore, A.N. Patil,” Energy Efficient Scheduling Scheme for virtual machines in cloud computing” International journal of Computer Application, Vol.56, 2012, Number 10.
[11] Shailesh Deore, A.N. Patil,” Energy Efficient Scheduling Scheme for virtual machines in cloud computing” International journal of Applied Information System, Vol.5, 2013, Number 5.
[12] VirtualBox website: www.Virtualbox.org
[13] Aman kansal, Feng Zhao, jie Liu, Nupur Kothari, Arka A. Bhattacharya (2010), “Virtual machine power metering and provisioning”, copyright 2010 ACM.
[14] Physics conversation website: www.physics.org..
[15] Deore S., “Design and Optimization of Scheduling Schemes For Cloud Computing” Ph.D. Engg. thesis, Shri J J T University, Rajasthan, India, October 2013.
[16] R. Buyya, Beloglazov A., Abwajy J.,” Energy-Efficient Management of Data Center Resources for Cloud Computing: A vision, Architectural elements, and open Challenges” In proc. Of 2010 International conference on parallel and Distributed Processing Techniques and Application, las Vegas, NV, USA.
[17] Francesc Guim, Ivan Rodero, Julita Corbalan, A. Goyeneche, “The Grid Backfilling: A Multi-site data mining architecture with data mining prediction techniques”, 2008, Grid middleware and services, published by Spinger US, pp.137-152.
[18] Joulemeter1.2 available on: http://research.microsoft.com/en-us/projects/joulemeter/
[19] Shailesh Shivaji Deore. (2016), “Comparison of Energy Efficient Scheduling Schemes for Private Cloud Environment ”, International Journal of Advance research in Computer and Communication Engineering Vol. 5, Issue 3, March 2016.
[20] W. L. Bircher and L. K. John,“Complete system power estimation: Atrickle-down approach based on performance events”, In International Symposium on Performance Analysis Systems and Software (ISPASS),2007.
[21] H. Zeng, C. S. Ellis, A. R. Lebeck, and A. Vahdat, “Ecosystem: managing energy as a first class operating system resource”, In ASPLOS-X: Proceedings of the 10th international conference on Architectural support for programming languages and operating systems, pages 123–132, 2002
[22] D. Economou, S. Rivoire, C. Kozyrakis, and P. Ranganathan, “Full-system power analysis and modeling for server environments”, In Workshop on Modeling, Benchmarking and Simulation (MoBS), June 2006.
[21] F. Bellosa, “The benefits of event-driven energy accounting in power-sensitive systems”, In In Proceedings of the 9th ACM SIGOPS European Workshop, 2000.
[22] X. Fan, W.-D. Weber, and L. A. Barroso, “Power provisioning for a ware house-sized computer” ,In Proceedings of the International Symposium on Computer Architecture (ISCA), June 2007.
[23] J. Zedlewski, S. Sobti, N. Garg, F. Zheng, A. Krishnamurthy, and R. Wang, “Modeling hard-disk power consumption”, In 2nd USENIX Conference on File and Storage Technologies (FAST), 2003.
[24] Stoess Jan, Christian Lang, Marcus Reainhardt (2006), “Energy aware Processor Management for VMs”
[25] A. Sinha and A. P. Chandrakasan, “Jouletrack: a web based tool for software energy profiling”, In 38th Conference on Design Automation (DAC), pages 220–225, 2001.
[26] T. Stathopoulos, D. McIntire, and W. J. Kaiser, “The energy endoscope: Real-time detailed energy accounting for wireless sensor nodes”, In 7th international conference on Information processing in sensor networks (IPSN), pages 383–394, 2008
[27] S. Rivoire, P. Ranganathan, and C. Kozyrakis, “A comparison of high-level full-system power models” ,In HotPower’08: Workshop on Power Aware Computing and Systems, December 2008.
[28] Y. Bao, M. Chen, Y. Ruan, L. Liu, J. Fan, Q. Yuan, B. Song, and J. Xu, “HMTT: A platform independent full-system memory trace monitoring system” ,In ACM Sigmetrics, June 2008.
[29] D. Economou, S. Rivoire, C. Kozyrakis, and P. Ranganathan, “Full-system power analysis and modeling for server environments”, In Workshop on Modeling, Benchmarking and Simulation (MoBS), June 2006.
[30] A. Mahesri and V. Vardhan, “Power consumption breakdown on a modern laptop”, In Power-Aware Computer Systems, 4th International Workshop (PACS), Portland, OR, USA, December 2004.

BIOGRAPHY

Dr. Shailesh Deore was born in Dhule, Maharashtra, India, in 1982. He received the B.E. degree in Computer Engineering from the North Maharashtra University, Maharashtra, India, in 2003, and Ph.D. degrees in Computer Engineering from the Shri J J T University, Rajasthan, India, in 2014. In 2004, he joined the Department of Computer Engineering of SSVPS’s B S Deore, COE, Dhule affiliated to North Maharashtra University as a Lecturer, and in 2009 became a Assistant Professor. Since till date, he has been with the Department of Computer Engineering, Dr. Deore current research interests cloud computing, Energy Efficient Job scheduler algorithms, Schemes in private cloud environment.