Mobile Apps For Measuring Green Environment Parameters in Data Center

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***Abstract*— The cloud computing is the evolving area in which multiple datacenters are placed in different location for providing data and service to customer and users worldwide. The various performance measures for the efficient cloud computing data center are (PUE) Power Usage Effectiveness, (DCiE) Data center Infrastructure Efficiency, (CPE) Compute Power Efficiency, (GEC) Green Energy Coefficient, (ERF) Energy Reuse Factor, (CUE) Carbon Usage Effectiveness, (WUE) Water Usage Effectiveness, (DCP) Data Centre Productivity, (DCeP) Data Centre Energy Productivity, (SWaP) Space, Wattage and performance. The performance measure and data center servers has gained more importance due to cost effectiveness and customer satisfaction. However customer disagreement can be cause if performance measure is not provided by the data center as specified in SLA. In this paper we present a novel collaborative approach to measure the various performance of the datacenter through a novel real-time collaborative mobile apps application on smart phone to let customer and data center provide interaction in an efficient way.**

Keywords—Green Cloud Computing; performance measure; mobile Apps

I. INTRODUCTION

We are living in a new technology era with many kinds of constraints. Energy consumption is one of the major constraint for information sharing, computing and communication. The high energy consumption of data centers often results in consumption of electricity produced by "brown" generation facilities, resulting in high emission of carbon dioxide, with negative impacts on the environment. The common economic objective of Cloud providers is to minimize their total deployment and operational costs. High energy consumption directly contributes to both deployment and operational costs. As analyzed in [1], the electricity consumption for powering the data centers in the USA alone is projected to reach 100 billion kWh at the cost of $7.4 billion by 2011. This power consumption contributes up to 42% of a datacenter's monthly budget[2].Therefore, energy consumption, as well as its impact on system performance, operating cost and the environment, have become critical issues in Cloud environments [3].Green cloud computing aims to reduce cost and co2 emissions as well as to effectively reduce and replace power usage.

However, energy consumption and system performance of data center vary greatly with different system resource configuration and allocation strategies, as well as the workload and types of running tasks in the Cloud .Various performance measure for efficient cloud computing data center are (PUE) Power Usage Effectiveness , (DCiE) Data center Infrastructure Efficiency, (CPE) Compute Power Efficiency, (GEC) Green Energy Coefficient, (ERF) Energy Reuse Factor, (CUE) Carbon Usage Effectiveness, (WUE) Water Usage Effectiveness, (DCP) Data Centre Productivity, (DCeP) Data Centre Energy Productivity, (SWaP) Space, Wattage and performance. By its nature, these Cloud workloads is a highly variable and application-specific. In addition, system performance should not be impacted while energy consumption is being minimized. Thus in order to achieve this, a thorough understanding on the performance parameter is needed by both customer and data center provider. In addition, the correct performance measure tools are needed. However, there are still some major challenges that need to be addressed:

- What parameters can be used for green cloud computing performance measure?
- How the parameters can be calculated?
- How the calculated parameter values can be transferred from datacenter to the customer?
- How the parameter values can be viewed by the customer/provider in his smart phone?

In order to identify these challenges, we propose a new collaborative approach to measure the various performance of the data center through a novel real-time collaborative mobile apps application on smart phone for Cloud environments. Our real-time collaborative mobile apps application considers various parameter metric to calculate the energy consumption in Cloud environments. The mobile apps get the various parameter values from the datacenter as XML file and display the values in the customer as well as datacenter provider's mobile phone. It helps identifying the extend to which the datacenter is providing the contribution towards green cloud computing. Our mobile apps can be used by both datacenter owners, service providers and the customers to choose the best datacenter for their usage. We briefly summarize the state-of-the-art of tools and analysis approaches in Section II.In section III we have explained about various performance metric used to calculate the performance of green cloud computing. In Section IV, we introduce our mobile apps for performance measure in Cloud environments. Finally, we conclude the paper by discussing the advantage of our Apps in Section V.

II. Related Work

Performance measure in Cloud computing environments has quickly become a popular research topic. Several efforts have been made to build energy consumption models and develop energy-aware cost models for optimizing the total cost, i.e., deployment cost plus operational cost, in Cloud environments. Li et al [4] propose a cost model for calculating the total cost of ownership and utilization cost in Cloud environments. They also developed suites of metrics for this calculation. However their calculation granularity is a single hardware component. A consumer-provider Cloud cost model has been proposed by Mach and Schikuta [5]. Their energy consumption calculation is based on the number of Java Virtual Machine (JVM) instances on each server. However, it is hard to measure the actual numbers of JVM because of the dynamic nature of JVM life cycle. Greencloud[6] is a sophisticated packet-level simulator for energy-aware cloud computing data centers with a focus on cloud communications**.** It offers a detailed fine-grained modeling of the energy consumed by the data center IT equipment, such as computing servers, network switches, and communication links.GreenCloud can be used to develop novel solutions in monitoring, resource allocation, workload scheduling as well as optimization of communication protocols and network infrastructures. It is released under the General Public License Agreement and is an extension of the well-known NS2 network simulator.Zenoss Cloud Monitoring[7] monitors public, private, or hybrid cloud environments with a unified visibility and provides real-time awareness of the entire infrastructure. Zenoss ensures relevance through a model-driven cloud operations management system which maintains a comprehensive model of every device's hardware, software and network relations which then makes use of that model to ensure that the right monitoring service and policies are implemented on that device.RevealCloud[8] is a server health and performance monitoring tool provided by CopperEgg. It provides broad visibility across both private and public cloud environments that organizations may have. It uses cross-correlation analytics which help operation teams to quickly find and isolate root causes of problems and issues in the cloud, it is designed to be used in the server side.RevealUptime[9] is another solution from CopperEgg which is best paired with RevealCloud to provide correlated data between end user experience measurements provided by ReevalUptime and server health status data from RevealCloud. This allows administrators to better understand what their users are experiencing as well as the reason for that experience in relation to the cloud and servers.Gomez APM (Compuware's Gomez Application Performance Management (APM))[10] provides a holistic approach to cloud monitoring of application performance along the whole delivery chain. The tool provides detailed information on the root cause of problems and how much impact it has on the entire system and business. This allows IT teams to home in on the problems fast and prioritize the critical ones. The main feature of this APM is its fault domain isolation which determines the area at fault whether it is the ISP or the internet connection itself, a third party provider, the data center, or even the user-end browser or device.Rackspace Cloud Monitoring[11] is an API driven monitoring system which allows administrators to use or create APIs depending on their needs which can send notifications to any device including mobile devices. This allows administrators to be on top of their Rackspace-hosted infrastructure which includes websites, protocols, and ports.Some of the above mentioned tools are used to benchmarking the energy and system performance,hardware performance,software and network performance. However, none of them is used to measure the performance metric of Green Cloud Computing in Cloud environments as well as system performance. In this paper, we propose a new novel approach to provide collaborative approach to measure the various performance metric of the data center through a novel real-time collaborative mobile apps application on smart phone.

III. Performance Metric for Green Cloud Computing

A. Power Usage Effectiveness(PUE)

It is used for comparison of energy used by computing application and infrastructure Equipment and the energy wasted in overhead. The PUE can be described as the ratio of overall electricity consumed by the facility of a data center to the overall electricity consumed by IT equipment.

$$\mathrm{PUE} = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}}$$

B. Data center Infrastructure Efficiency(DCiE)

It is the reciprocal of PUE. PUE and DCiE are most commonly used metrics that were designed for the comparison of efficiency of datacenters.IT Equipment Power can be described as the power that data center has taken for the management of IT equipment's, processing of IT equipment's and storing the data in disk drives or routing the data within the datacenter.

$$DCiE = \frac{1}{\mathrm{PUE}}$$

C. Compute Power Efficiency(CPE)

It is a measure of the computing efficiency of a datacenter.

$$CPE = \frac{\text{IT equipment utilization}}{\text{PUE}}$$

ISSN 2229-5518

D. Green Energy Coefficient

It is a measure of green energy (energy that comes from renewable sources) that is used by the facility of a datacenter.

$$GEC = \frac{\text{Green Energy Consumed}}{\text{Total Energy Consumed}}$$

E. Energy Reuse Factor(ERF)

It is a measure of reusable energy (energy that is reused outside of datacenter) that is used by datacenter.

$$ERF = \frac{\text{Reused energy used}}{\text{Total Energy Consumed}}$$

F. Carbon Usage Effectiveness

It is a measure of carbon dioxide emission in environment by the data center.Where ECO2: Total carbon dioxide emission from total energy absorbed by the facility of a data EIT: Total energy consumed by IT equipment.

$$CUE = \frac{E_{CO2}}{E_{IT}}$$

G. Water Usage Effectivenes(WUE)

It is a measure of required water by a data center annually

$$WUE = \frac{\text{Water Used Annually}}{E_{IT}}$$

H. Data Centre Productivity(DCP)

It is a measure of amount of fruitful work yielded by datacenter.

$$DCP = \frac{\text{Useful Work Done}}{T_{resource}}$$

I. Space, Wattage and performance(SWaP)

It is a Sun Microsystems metric for datacenters. It is developed for computing the energy and space requirement of a datacenter.

$$SWaP = \frac{\text{Performance}}{\text{Space} * \text{Power}}$$

IV. Mobile Apps For Green Cloud Computing(MAGCC)

A central server is used for the Mobile apps applications running on multiple Smartphones to work together towards a shared collaborative task of getting parameter values from various datacenters. Fig 1 depicts the MAGCC Apps system architecture consisting of a MAGCC server, a MAGCC apps application on Smartphones, and a MAGCC client on the Datacenter console. The MAGCC server provides essential services to the MAGCC application on Smartphones and the MAGCC client on the Datacenter console as well as a repository that stores all the parameter values for calculating the performance. The MAGCC application runs on each Smartphone and does what have been described in the above section through the services provided by the server. The MAGCC client runs on the Datacenter console and it is completely up to the Datacenter owner to decide on whether they want to make use of it. The customers can use it to monitor each datacenter's performance values dynamically.

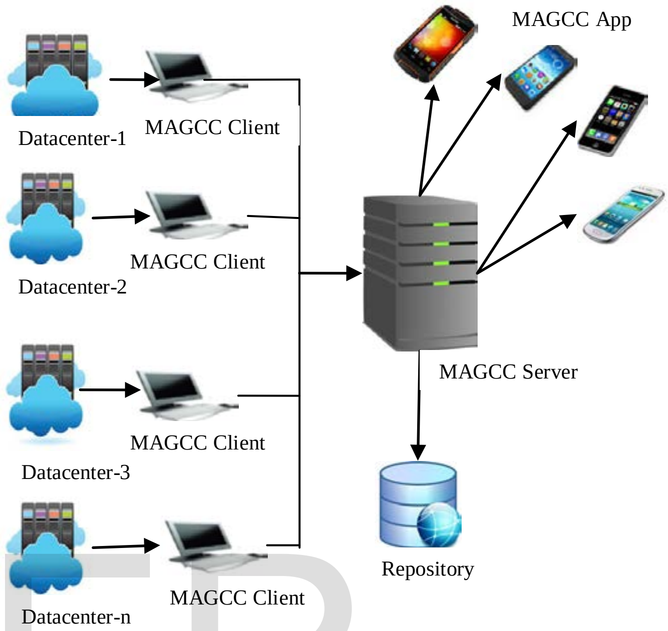
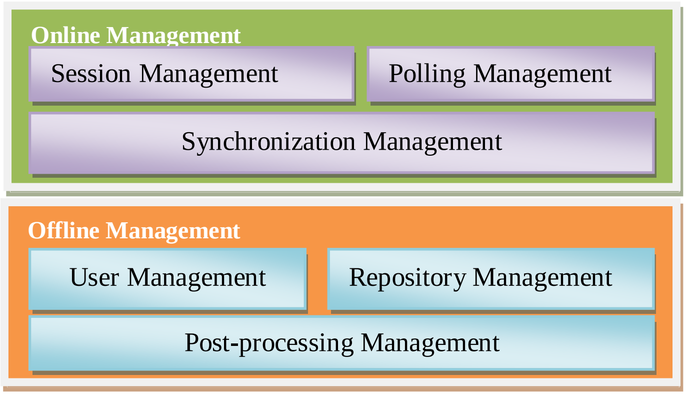


Fig. 1. MAGCC Apps System Architecture

The services provided by the MAGCC server can be broadly divided into online management and offline management. Online management consists of essential services required by the MAGCC application and client during a performance calculation phase. The online management consists of three sub services such as session management, Synchronization management and Polling management. The offline management consists of three sub services such as User management, Post-processing management and repository management. Various services present in MAGCC service is depicted in the Fig2.



International Journal of Scientific & Engineering Research, Volume 7, Issue 4, April-2016
ISSN 2229-5518

Fig, 2. Services provided by MAGCC Server

A. *Session management*

In particular, session management is to create a session for each customers and handle session related activities such as joining/leaving an ongoing session, getting performance value of the session back to the repository, adjusting customers roles in the session, making the customer to join the session, recovering from errors or application crashes and so on. The technical solution to session management is based on Xia et al.'s work [12], but extended to cater for the wireless Smartphone environment

B. *Synchronization management*

Synchronization management handles everything related to shared access to a parameter metric values stored in the MAGCC Server, including optimistic concurrency control – when multiple datacenter server need to concurrently write to the same MAGCC Server, consistency maintenance – replicas of the parameter values on each customer's MAGCC applications are kept consistent throughout the session in the sense that each update to the MAGCC server is consistently applied to all replicas, the order in which updates are applied to the MAGCC server is consistently maintained across all replicas, and the all replicas are identical at the end of the session, and so on. The technical solution to synchronization management is extended from the operational transformation technique [13] to cater for the wireless Smartphone environment.

Fig, 3. Registration Form to register with the datacenter.

C. *Polling management*

Polling management supports vertical interaction by offering the standard question-and-response feature, e.g., the Datacenter owner can assign value for the parameter through the MAGCC client and customers can use their MAGCC application to view the parameter values provided by the datacenter owners, e.g., a customer can use their MAGCC application to interact with the Datacenter (asking parameter values, giving datacenter to view etc.) through the MAGCC client on the datacenter console.

D. *Offline management*

Offline management consists of services to be used by the MAGCC application or client when there is no internet facility. These services are usually used before or after the monitoring of the parameter values.

E. *User management*

User management is for a customer to create their login accounts to the system, update their profiles (e.g., parameters to view, datacenter they needs to view), customize their preferences (e.g., preferred color for their identities in a session, preferred role in a session), and so on. The user can registration to the available datacenter and the display of various parameter values for selected datacenter is shown in the Fig 3 and Fig 4.

F. *Post-processing management*

Post-processing management is to reconcile all the parameter values (e.g., reconciling each parameter from each datacenter or selected datacenter) to generate combined analyzed result for customer and the provider to have a better understanding on how well each of the datacenter is performing.

Fig, 4. Parameter value dispayed for selected datacenter of the customer

G. Repository management

Repository management is for customers or the datacenter provider to view or download the parameter values, or reconciled parameter values they have access to.

V. Conclusion

Green computing represents a responsible way to address the issue of global warming. By adopting green computing practices, business leaders can contribute positively to environmental stewardship-and protect the environment while also reducing energy and papercost.Performance Metrics defined for making energy efficient system focuses on reduction of CO2 emission in environment and Green House Gases effect also reduced in a large amount. This paper propose a novel approach to provide collaborative approach to measure the various performance metric of the data center and display the performance value in service provider and customers smartphone through a novel real-time collaborative mobile apps. As we are moving towards cloud and using its application in every field such as disaster management, service provisioning, online data storage, data retrieval from any place at any time etc.The mobile apps we created can ensure that the datacenter is environment friendly.

References

[1] "Report to congress on server and data center energy efficiency," U.S. Environmental Protection Agency, August 2, 2007

[2] J. Hamilto, "Cooperative expendable micro-slice servers (CEMS): low cost, low power servers for internet-scale services," in the 4th Biennial Conference on Innovative Data Systems Research (CIDR 2009), Asilomar, California, USA, 2009, pp. 1-8I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.

[3] J. Baliga, R. W. A. Ayre, K. Hinton, and R. S. Tucker, "Green cloud computing: balancing energy in processing, storage, and transport," Proceedings of the IEEE, vol. 99, no. 1, pp. 149-167, January 2011.

[4] Z. Zhang and S. Fu, "Characterizing power and energy usage in cloud computing systems," in the 3rd IEEE International Conference on Cloud Computing Technology and Science (CloudCom 2011), Athens, Greece, 2011, pp. 146-153

[5] W. Mach and E. Schikuta, "A consumer-provider cloud cost model considering variable cost," in the 9th IEEE International Conference on Dependable, Autonomic and Secure Computing(DASC 2011), Sydney, Australia, 2011, pp. 628-635.

[6] https://greencloud.gforge.uni.lu/index.html

[7] http://www.zenoss.com/solution/cloud-monitoring

[8] http://cloudtweaks.com/2012/03/copperegg-revealcloud-v3-delivers-first-real-time-system-process-monitoring-service/

[9] https://www.idera.com/infrastructure-monitoring-as-a service/application-performance-monitoring-tools

[10] http://www.dynatrace.com/en_us/application-performance-management.html

[11] http://www.rackspace.com/cloud/monitoring

[12] Xia, S., et al., A Collaborative Table Editing Technique Based on Transparent Adaptation, in On the Move to Meaningful Internet Systems 2005: CoopIS, DOA, and ODBASE, R. Meersman and Z. Tari, Editors. 2005, Springer Berlin / Heidelberg. p. 576-592

[13] Shen, H. and C. Sun, Flexible notification for collaborative systems, in Proceedings of the 2002 ACM conference on Computer supported cooperative work. 2002, ACM: New Orleans, Louisiana, USA.