A COMPARATIVE – CONTRASTIVE INTEGRATION BETWEEN GREENCLOUD AND DYNAMIC DATA CENTER POWER MANAGEMENT (DDCPM)

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Abstract

Power saving stands as a core challenge among data center operators in the middle of the increasing cost of energy and cooling. It's important to firstly examine the brief definition of each side of the coin in this paper, which handles two approaches in tow papers bring out new approaches to deal with power consumption. The first in (Liu et al., 2009) is titled GreenCloud: A New Architecture for Green Data Center and the second is Dynamic Data Center Power Management: Trends, Issues, and Solutions in (Filani et al., 2008). In (Liu et al., 2009) GreenCloud is basically a new architecture (structure) for Green (online) data center, whereas in (Filani et al., 2008) the so-called DDCPM signifies a wise approach for boosting power allocation inside a certain "power envelope" and raise server density in data centers. On the other hand, we hereby aims to attach the concept of Virtual Machine (VM) technology in (Liu et al., 2009) to GreenCloud, and the concept of Policy Manager in (Filani et al., 2008) to the said DDCPM term. Some more relevant topics and terms would be presented as well.

Keywords: Green Cloud Computing, Virtualization, dynamic power management, Internet data center (IDC), data center operations, energy efficiency, platform management policy

Introduction

Improving data center energy efficiency is becoming a core requirement for most organizations, not only to contain operating costs, but also to support growth (Corporation, 2010). Electricity costs are rising fast (Harris, 2011). There are cases in which power costs reach 50% of the aggregate data center operation budget! Hence we are to set forth the facets of solution data for this exhausting problem, addressing the case in both a comparing and contrasting manner when and where applicable. Remarkably, GreenCloud is an Internet Data

Center (ICD) architecture which seeks to minimize data power consumption (expenditure). DDCPM has the same objective but its own framework. Data Centers and Operators today are generally facing an average increase of 400% in the cost of power and cooling! Yet, it is comparatively good news to learn that the GreenCloud architecture can save up to 27% of energy. By comparison, on the other hand, DDCPM endeavors among its planners and handlers to deploy more serves to sustain new business solutions .To differentiate through contrasting, a recent survey (Figure 1) deems server deployment inappropriate based on the fact that many Data Centers see the costly power and cooling as a key factor in limiting the aforementioned deployment. Data centers see the GreenCloud implementation as more convenient on an expenses basis. Meanwhile Deploying new services / servers is having a negative trend of being constrained, so Data Centers have been thinking of employing a power management solution to boost the utilization of current (existing) capacity. The rest of this paper is organized as the following. We first briefly summarize the Cloud Computing in (Liu et al., 2009) and current power allocation in (Filani et al., 2008) in Section 1. In Section 2, we introduce the power management in IDC in (Liu et al., 2009) and dynamic power management approach in (Filani et al., 2008). In (Liu et al., 2009) the virtual machine power management and migration is studied in Section 3. We present GreenCloud evaluation and Policy-Driven approach to power management (PDAPM) in (Filani et al., 2008) In Section 4. Section 5 handles additional worthy comments on GreenCloud architecture and dynamic management approach with our suggested approach. Comparison of energy consumption and brief case studies demonstrating the value of the above (PDAPM) is handled by section 6. Finally, we conclude the paper in Section 7.

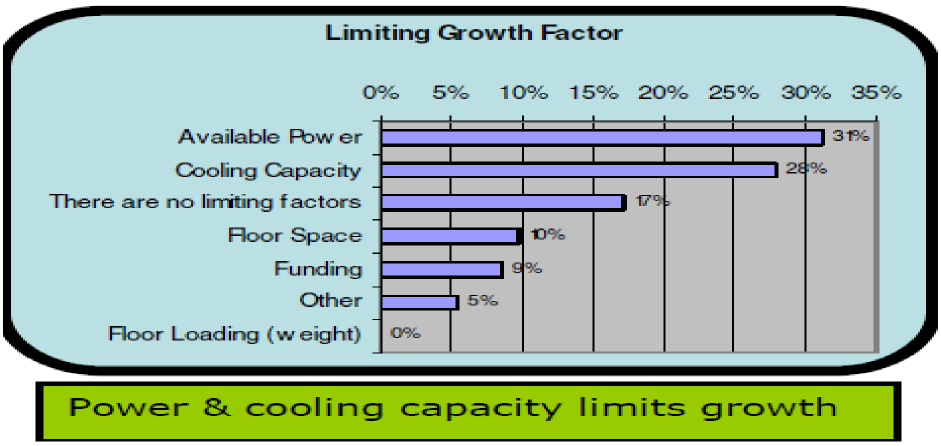

Figure 1: Factors limiting server growth (Filani et al., 2008)

Cloud Computing And Current Power Allocation Methods

Cloud Computing signifies the idea of dynamically providing time of processing and storage area from a ubiquity (omnipresent) “cloud” of computational resources. Moreover, it allows the relevant users of data centers and operations to gain and release the data resources upon demand (Huth & Cebula, 2011). On the other hand, utilizes methods of presentation (current) allocation, heeding the maximum consumption of energy per a given server; Here a fixed amount of power is delivered to data room and then to every rack. The present allocation method (current allocation approach) of energy is a static one that does not lead to an optimal result, since it rather results in wastage and high costs (Filani et al., 2008). Thus a better approach is needed which is indicated below.

Power Management In Idc And Dynamic Power Management Approach

Management of power in an Internet Data Center (IDC) is not easy! For instance, management of power, which one might call energy saving, requires a consequent unharmed and good performance level of data processors, servers and software. The Dynamic Power Management Approach is a good and suitable method of reducing power consumption; its unique characteristic amongst other competing which is based upon measurement of actual power consumption. In this context, it is fruitful to dynamically allocate the amount of energy each server and rack (thus room) is consuming. In this approach also, energy to groups of server could be dynamically allocated and shifts of power needs of server is attainable properly. In this context, While in DDCPM a server is furnished with the power necessary to operate it and process its data in a manner that is just fit quantitatively (with neither excess nor deficiency), we see on the other hand that in GreenCloud architecture execution (implementation) the workload is transferred (shifted) to another server in a data center and the source servers or other computer-related devices are put to switched off (Liu et al., 2009).

Virtual Machine Power Management And Migration

A virtual machine is one that mediates between the guest operating systems and the hardware (King et al., 2003). Its power is managed (declined) by transitioning the elements of the hardware to states of less power while preserving performance. Migration of the Virtual Machine signifies moving it from one place to another by users working on various machines at various times. This helps transfer an operating system instance through tardy linkages and prolonged time periods. Live migration could be used by moving VM among servers while constantly operating, without affecting the users. Figure 2 shows the structural flow of processes within describing GreenCloud Architecture, with some basic elements around migration. The GreenCloud Architecture in a general sense assists firms / companies in strengthening computing resources, minimizing administrative difficulties and speeding the reactions to the work dynamics.

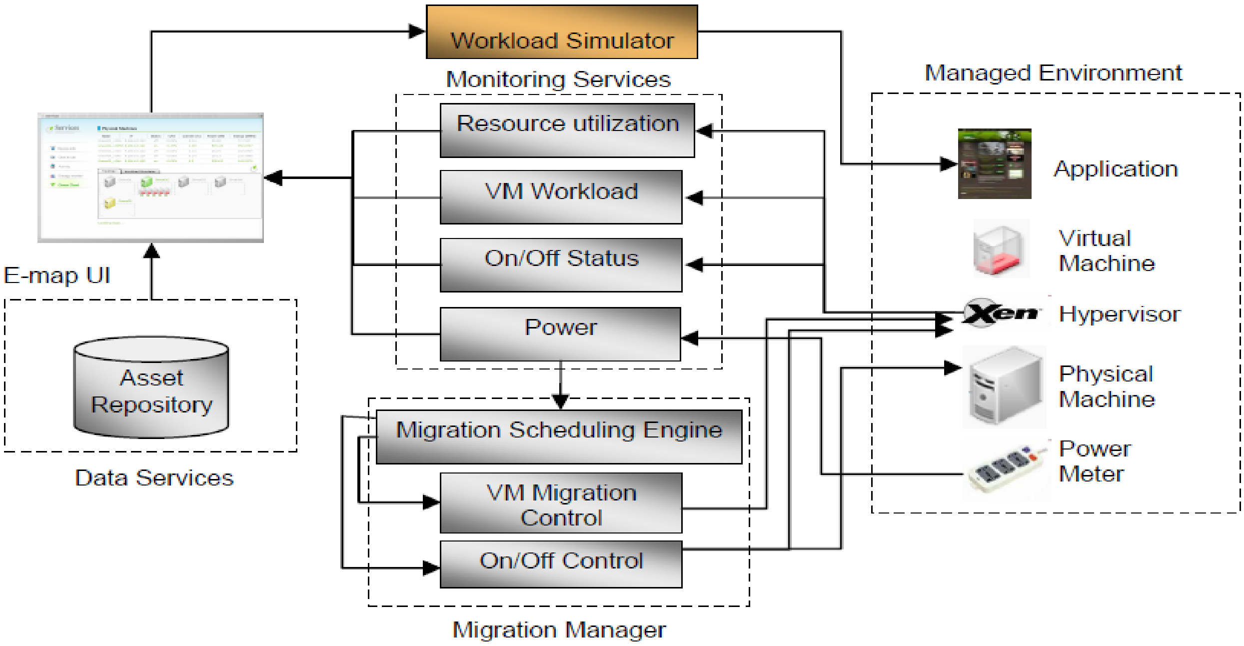

Figure 2. GreenCloud Architecture (Liu et al., 2009)

Greencloud Evaluation And Policy-Driven Approach To Power Management (PDAPM)

Xen has provided us with the VM live migration GreenCloud method (Shen et al., 2011). This has been granting us better power efficacy. To evaluate it, an experimental setup has been carried out in the IBM China Research Lab (CRL) in the form of a prototype. A response time-sensitive online game, named "Tremulous" served well for evaluation purposes. The players could not sense the little delay caused by the server migration. Tables 1 and 2 describe this by configuration of VM (Virtual Machines). Meanwhile, it is worth mentioning to examine here a modern Policy-Driven Approach to Power Management (PDAPM). The approach is consistent with an ideal data center driven by deploying management structures for supervising the well-being of the computing basic structure and executing different management tasks comprising error investigation, failure solving, service deployment to servers, and server provisioning. Figure 3 briefly outlines these processes in this approach.

Table 1. Physical Machine in GreenCloud (Liu et al., 2009)

Physical Machine	Type	CPU	Memory	Network	WOL Support	NFS Server
Green01	X336	3.0G (2 Core)	3.0G	2 *1 Gigabyte	Y	N
Green02	X3950	3.0G (16 Core)	16.0G	2 *1 Gigabyte	Y	Y
Green03	X346	3.0G (4 Core)	3.0G	2 *1 Gigabyte	Y	N
Green04	X346	3.0G (4 Core)	3.0G	2 *1 Gigabyte	Y	N
Green05	X346	3.0G (4 Core)	3.0G	2 *1 Gigabyte	Y	N

Table 2. VM Configuration in GreenCloud(Liu et al., 2009)

Virtual Machine	Type	CPU	Memory	NFS Booting Support	Gaming application
VM01	ParaVirt	2 Core	2.0G	Y	Tremulous
VM02	ParaVirt	4 Core	2.0G	Y	Tremulous
VM03	ParaVirt	4 Core	2.0G	Y	Tremulous
VM04	ParaVirt	4 Core	2.0G	Y	Tremulous
VM05	ParaVirt	4 Core	2.0G	Y	Tremulous

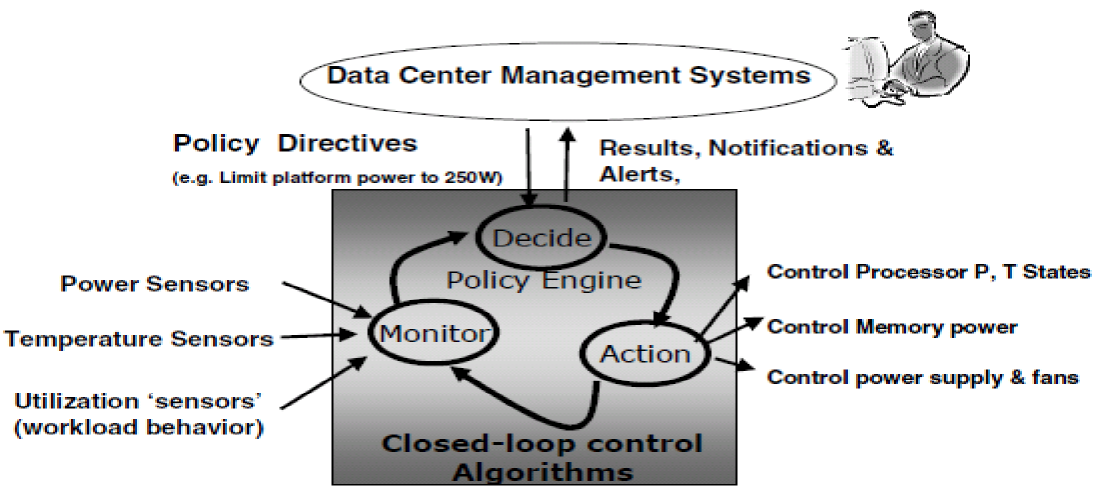

Figure 3. Power Management architecture (Filani et al., 2008)

Additional Worthy Comments On Greencloud And Dynamic Management Approach With Suggestion Approach

GreenCloud Architecture is designed to handle the difficulties in exploiting and enhancing computing resources, as well as furnish a cloud computing environment which hits the challenging target of reducing power consumption. In (Liu et al., 2009) as implied in Figure 2, we can further infer how the system controls various factors and performance measures, whereas it is possible to dynamically adjust workload and utilization of resources. Meanwhile, researchers in (Filani et al., 2008) underline a crucial power policy called “Power Capping” which plays the role of a safety valve to protect the energy distribution structure against overdraw. It also provides effective enhancing rack population. The issue has been one of the core interests among the decade’s Data Centers and Internet Operators. Practical success in this quest has been coming under light, as well as Power Management and its dynamic approach bring further scientific elaboration , through the relatively giant steps already crossed in this aspect . As a suggestion in this paper the integration between GreenCloud and, DDCPM to merge them and treat their day-by-day updates and requirements. Each has its own specialists, although there have been points of common interests and links between the two sides. The interaction between GreenCloud while linked with Cloud Computing in (Liu et al., 2009) and Dynamic Power Management in (Filani et al., 2008) being mainly exemplified by the dynamic approach, suggests that actual power consumption and real-time power monitoring (in terms of servers and server subsystems) are both time-related; in other words, energy needed for each server and its components (CPU, memory, disks, fans, etc.) shall be measurable at any moment in time. As a result, of the integrated approach above is that the migration of the workload can be done and switched off the idle server while the working server is allocated with the fit power.

Comparison Of Energy Consumption & Brief Case Studies Demonstrating The Value Of Above Pdapm

Having briefly set forth our above basic evaluation of GreenCloud , it is remarkable in this context to take a quick look at the comparison of energy consumption graph simply drawn in Figure 4 , where It is stressed that the evaluation is in accord with the energy-saving fact of the GreenCloud Architecture. The energy unit the graph suggests is a kilowatt per hour (KWH).

In terms of case studies, many have been conducted, the most successful of which have proven the value and benefit of a policy-based dynamic power management approach utilizing the so-called “platform-resident power management “. Such Power Management (PM) has been executed finely exploiting the following two sets of experiments in (Filani et al., 2008):

(a) Pilot data center set: PoC (Proof of Concept) has been effected at a top Internet portal customers’ data center to maximize the server’s number in each rack within a power/energy envelope while heeding good performance. The basic result of our PoC is finely summarized in Table 3.

Table 3: PM Test Result on a Single Node (Filani et al., 2008)

PM Setting	Platform Power Consumption	Workload	CPU Utilization	Search Time
No PM	310W	1,468 concurrent searches	67.81%	4.79ms
PM Power Capping 265 W	270W	1,514 concurrent searches	67.83%	4.69ms

(b) Experimental labs set: Here the value of PM was again explored by establishing polices at various levels. Servers were integrated under management testing, while considering the best possible performance. Here, servers were typically populated in the first Rack (See Figure 5). Using the PM (Rack#2) additional servers could be populated in a rack up to 21% more. This was further noticed in Rack #3 with server density of 28%. A remarkable and important fact has been extracted the value of PM has been found to be dependent on the actual application running on the server, the typical workload, and configuration of the server itself.

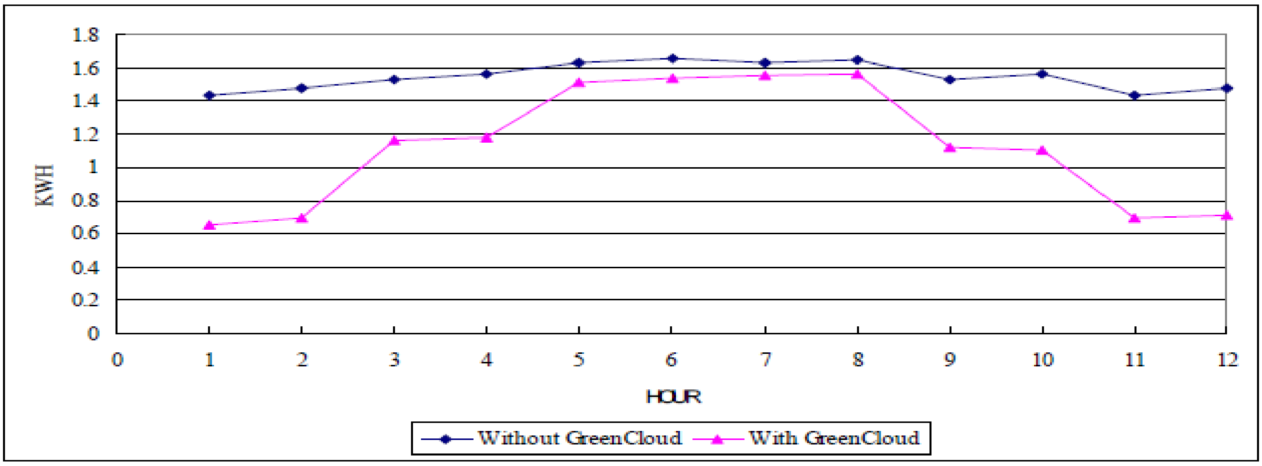

Figure 4. Comparison of Energy Consumption(Liu et al., 2009)

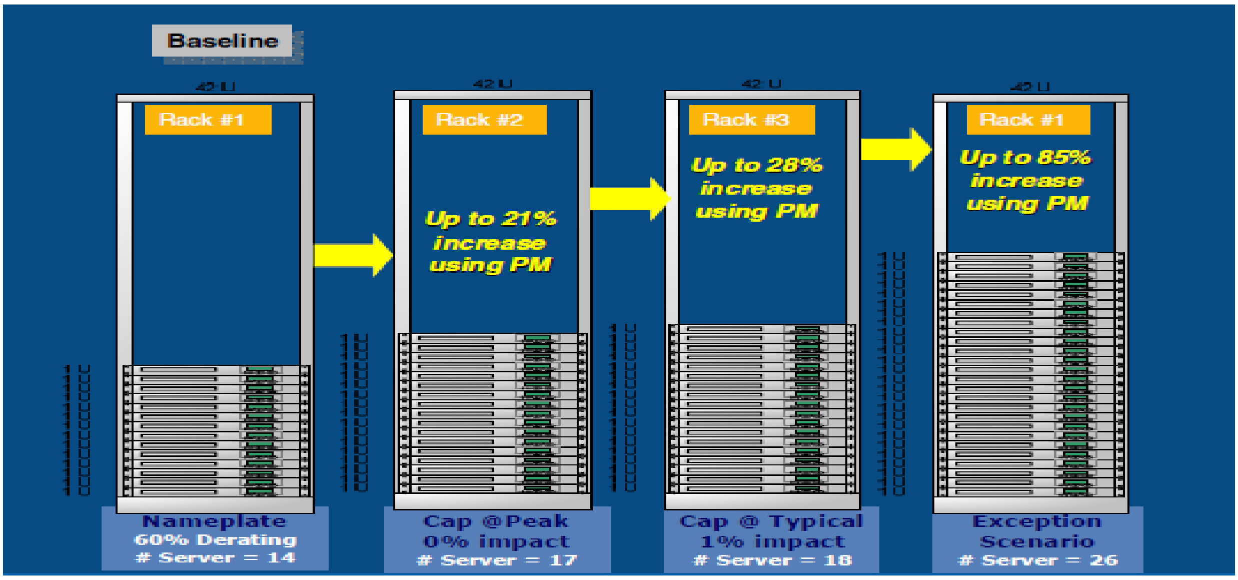

Figure 5. Policy Manager case study (Filani et al., 2008)

Conclusion

GreenCloud with its Cloud computing are two significant facets of today's business, due to the booming cost of energy needed in the form of electric power and cooling requirement , while minding best performance. To attain such targets, GreenCloud (Architecture) considers the so-called virtual machine (VM) migration approach. Evaluations have demonstrated the efficacy of GreenCloud approach. Meanwhile Dynamic Power Management capability is crucially necessitated to face power consumption and implement sound power policies in the middle of the present trends in Data Center power. This capability is attainable through PM (Policy Manager) being a dynamic policy-based power management approach. The near future seems to be bright in terms of further advancement in this serious and crucial field of energy saving. Our suggestions approach which telling that linking between the two sides expect to offer more power consumption.

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