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Real- Time Energy-Aware Virtualized Scheduling

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Abstract — ***The cloud, consisting of a collection of interconnected and virtualized computers dynamically provisioned as one or more unified computing resource(s), has become are evolutionary paradigm by enabling on-demand provisioning of applications, platforms, or computing resources for customers based on a "pay-as-you-go" model. The scheduling objectives are to improve the system's schedulability for real-time tasks and save energy. One of the important reasons about the extremely high energy consumption in cloud data centres can be attributed to the low utilization of computing resources that incurs a higher volume of energy consumption compared with efficient utilization of resources. The resources with a low utilization still consume an unacceptable amount of energy. Energy conservation is a major concern in cloud computing systems because it can bring several important benefits such as reducing operating costs, increasing system reliability, and prompting environmental protection. Meanwhile, power-aware scheduling approach is a promising way to achieve that goal. At the same time, many real-time applications, e.g., signal processing, scientific computing have been deployed in clouds. This paper review on the concepts of cloud computing, real time scheduling in virtualized environment. The energy aware scheduling in virtualized cloud is also discussed.***

Keywords— Cloud Computing, Virtualization, Real time tasks, Energy-aware, Scheduling.

I. INTRODUCTION

Cloud computing refers to software and hardware delivered as services over the Internet. The implementation of data mining techniques through Cloud computing will allow the users to retrieve meaningful information from virtually integrated data warehouse that reduces the costs of infrastructure and storage. Cloud computing is a network-based environment that focuses on sharing computations or resources. Actually, clouds are Internet-based and it tries to disguise complexity for clients. Cloud computing refers to both the applications delivered as services over the Internet and the hardware and software in the data centers that provide those services. Cloud providers use virtualization technologies combined with self service abilities for computing resources via network infrastructure.

The Cloud is referred to ,involvement to fusing computing resources – hardware and software– which combine delivers services over the Internet (Figure:1). Many companies accepts the third party to host them on its large servers instead of building their own IT infrastructure to host databases or software, so the company would have access to its data and software over the Internet.

The use of Cloud Computing is gaining popularity due to its mobility, huge availability in low cost. On the other hand it brings more threats to the security of the company's data and information. In recent years, data mining techniques are most using technique. Discovering knowledge in databases becoming increasingly vital in various fields: business, medicine, science and engineering, spatial data etc. The Cloud Computing provide sits users benefit of unprecedented access to valuable data that can be turned into valuable insight that can help them achieve their business Internet-based online services provides huge amounts of storage space and customizable computing resources, this computing platform shift ,however ,is eliminating the responsibility of local machines for data maintenance at the same time.

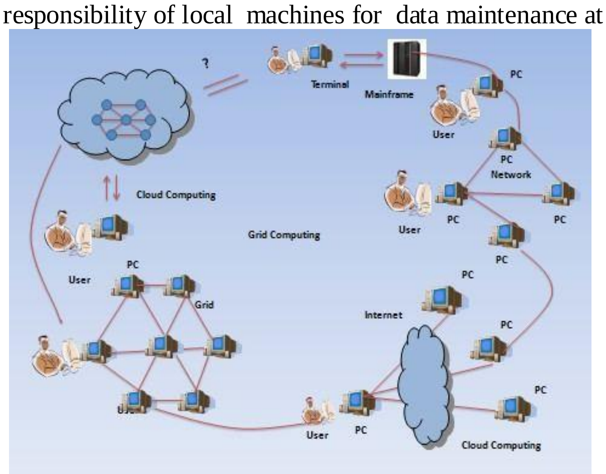

Fig. 1 Cloud computing scenario

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II. THE CLOUDONTOLOGY

Now-a-days Cloud computing has been promoted as a new paradigm and the 5th utility service after water, electricity, gas and telephony [6], [13].In the past, enterprises supported their business by procuring in formation technology infrastructure and developing theirs software on top of that infrastructure. Cloud computing presents a model in which information technology infrastructure is leased and used according to the need of the enterprise. The benefit of this model is that it converts capital expenditure o fan enterprise into operational expenditure [2].

One of the important reasons about the extremely high energy consumption in cloud data canters can be attributed to the low utilization of computing resources that incurs a higher volume of energy consumption compared with efficient utilization of resources. The resources with a low utilization still consume an unacceptable amount of energy.

According to recent studies, the average resource utilization (RU) in most of the data canters is lower than 30 percent [8], and the energy consumption of idle resources is more than70 percent of peak energy [9]. In response to the poor resource utilization, virtualization technique is an efficient approach to increase resource utilization and in turn reduce energy consumption. The virtualization technique enables multiple virtual machines (VMs) to be placed on the same physical hosts and supports the live migration of VMs between physical hosts based on the performance requirements. When VMs do not use all the provided resources, they can be logically resized and consolidated to the minimum number of physical hosts, while idle nodes can be switched to sleep or hibernate mode to eliminate the idle energy consumption and thus reduce the total energy consumption (TEC) in cloud data canters [3].

Cloud computing [20] systems fall into one of five layers: applications, software environments, software infrastructure, software kernel, and hardware. Obviously, at the bottom of the cloud stack is the hardware layer which is the actual physical components of the system. Some cloud computing offerings have built their system on subleasing the hardware in this layer as a service, we discuss in sub section IV-E. At the top of the stack is the cloud application layer, which is the interface of the cloud to the common computer users through web browsers and thin computing terminals.

A. Cloud Application Layer
B. Cloud Software Environment Layer
C. Cloud Software Infrastructure Layer
D. Software Kernel

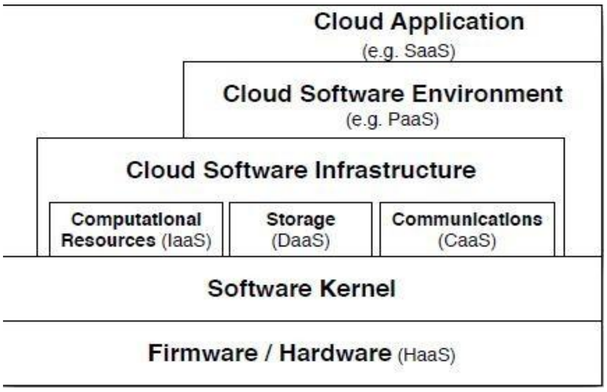

Fig. 2 Cloud architecture

In 2011 Narpat Singh Shekhawatand Durga Prasad Sharma defines hierarchy of natural classes of private cloud applications and show that no cryptographic protocol can implement those classes where data is shared among clients [21].

Energy conservation is a major concern in cloud computing systems because it can bring several important benefits such as reducing operating costs, increasing system reliability, and prompting environmental protection. Mean while, power-aware scheduling approach is a promising way to achieve that goal. At the same time, many real-time applications, e.g. signal processing, scientific computing have been deployed in clouds. Unfortunately, existing energy-aware scheduling algorithms developed for clouds are not real-time task oriented, thus lacking the ability of guaranteeing system schedulability.

It is worthwhile to note that to provide cloud services, more and more large-scale data centers containing thousands of computing nodes are built, which results in consuming tremendous amount of energy with huge cost [5]. Moreover, high energy consumption causes low system reliability since the Arrhenius life-stress model shows that the failure rate of electronic devices will double as the temperature rises by every 10 _C [6]. Furthermore, high energy consumption has negative impacts on environment. It is estimated that computer usage accounts for 2 percent of anthropogenic CO_2 emission. Data center activities are estimated to release 62 million metric tons of CO_2 into the atmosphere [7]. Consequently, it is highly indispensable to employ some measures to reduce energy consumption of cloud data centers and make them energy efficient.

III. LITERATURE SURVEY

Unfortunately, existing energy-aware scheduling algorithms developed for clouds are not real-time task oriented, thus lacking the ability of guaranteeing system schedulability. To address this issue, [2] propose in a novel rolling-horizon scheduling architecture for real-time task scheduling in virtualized clouds. Then a task-oriented energy consumption model is given and analysed. Based on our scheduling architecture, [2] develop a novel energy-aware scheduling

Algorithm named EARH for real-time, a periodic, independent tasks. The EARH employs a rolling-horizon optimization policy and can also be extended to integrate other energy-aware scheduling algorithms. Furthermore, we propose two strategies in terms of resource scaling up and scaling down to make a good trade-off between task's schedulability and energy conservation. Extensive simulation experiments injecting random synthetic tasks as well as tasks following the last version of the Google cloud trace logs are conducted to validate the superiority of our EARH by comparing it with some baselines. The experimental results show that EARH significantly improves the scheduling quality of others and it is suitable for real-time task scheduling in virtualized clouds.

Green computing and energy conservation in modern distributed computing context are receiving a great deal of attention in the research community and efficient scheduling methods in this issue have been overwhelmingly investigated [3],[4]. In a broad sense, scheduling algorithms can be classified into two categories: static scheduling and dynamic scheduling [5]. Static scheduling algorithms make scheduling decisions before tasks are submitted, and are often applied to schedule periodic tasks [6]. However, a periodic task whose arrival times are not known a priori must be handled by dynamic scheduling algorithms (see, for example, [7], [8]). In this study, we focus on scheduling a periodic and independent real-time task.

Chase et al. considered the energy-efficient management issue of homogeneous resources in Internet hosting centers. The proposed approach reduces energy consumption by switching idle servers to power saving modes and is suitable for power-efficient resource allocation at the data center level [9].

Zikos and Karatza proposed a performance and energy-aware scheduling algorithm in cluster environment for compute-intensive jobs with unknown service time [8]. Ge et al. studied distributed performance-directed DVFS scheduling strategies that can make significant energy savings without increasing execution time by varying scheduling granularity [10]. Kim et al. proposed two power-aware scheduling algorithms (space shared and time-shared) for bag-of-tasks real-time applications on DVS-enabled clusters to minimize energy dissipation while meeting applications' deadlines [11]. N_elis et al.investigated the energy saving problem for sporadic constrained-deadline real-time tasks on a fixed number of processors.

The proposed scheduling algorithm is pre-emptive; each process can start to execute on any processor and may migrate at runtime if it gets pre-empted by earlier-deadline processes [12]. It should be noted that these scheduling schemes do not consider resource virtualization, the most important feature of clouds, thus they cannot efficiently improve the resource utilization in clouds.

Nowadays, virtualization technology has become an essential tool to provide resource flexibly for each user and to isolate security and stability issues from other users [13].Therefore, an increasing number of data centers employ the virtualization technology when managing resources. Correspondingly, many energy-efficient scheduling algorithms for virtualized clouds were designed. For example, Liuet al. aimed to reduce energy consumption in virtualized data centers by supporting virtual machine migration andVM placement optimization while reducing the human intervention [13]. Petrucci et al. presented the use of virtualization for consolidation and proposed a dynamic configuration method that takes into account the cost of turning on or off servers to optimize energy management in virtualized server clusters [14]. Bi et al. suggested a dynamic resource provisioning technique for cluster-based virtualized multi tier applications. In their approach, a hybrid queuing model was employed to determine the number of VMs at each tier[15].

Verma et al. formulated the power-aware dynamic placement of applications in virtualized heterogeneous systems as continuous optimization, i.e., at each time frame, the VMs placement is optimized to minimize energy consumption and to maximize performance [16]. Beloglazovet al. proposed some heuristics for dynamic adaption of VM allocation at runtime based on the current utilization of resources by applying live migration, switching idle nodes to sleep mode [3]. Goiri et al. presented an energy-efficient and multifaceted scheduling policy, modelling and managing a virtualized data center, in which the allocation of VMs is based on multiple facets to optimize the provider's profit [17]. Wang et al. investigated adaptive model-free approaches for resource allocation and energy management under time-varying workloads and heterogeneous multi tier applications, and multiple metrics including throughput, rejection amount, queuing state were considered to design resource adjustment schemes [17]. Graubner et al. proposed an energy-efficient scheduling algorithm that was based on performing live migrations of virtual machines to save energy, and the energy costs of live migrations including pre- and post-processing phases were considered [18].

Unfortunately, to the best of our knowledge, seldom work considers the dynamic energy-efficient scheduling issue for real-time tasks in virtualized clouds. In this study, we focus on the energy-efficient scheduling by rolling-horizon optimization to efficiently guarantee the schedulability of real time tasks and at the same time striving to save energy by dynamic VMs consolidation.

IV. CONCLUSIONS

Using Cloud Storage, users can remotely store their data and enjoy the on-demand high quality applications and services from a shared pool of configurable computing resources, without the burden of local data storage and maintenance. The virtualization technique enables multiple virtual machines (VMs) to be placed on the same physical hosts and supports the live migration of VMs between physical hosts based on the performance requirements. When VMs do not use all the provided resources, they can be logically resized and consolidated to the minimum number of physical hosts, while idle nodes can be switched to sleep or hibernate mode to eliminate the idle energy consumption and thus reduce the total energy consumption in cloud data centers. This paper review on the concepts of cloud computing, real time scheduling in virtualized environment. The energy aware scheduling in virtualized cloud are also discussed.

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