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Energy Conscious Virtual Machine Migration by Job Shop Scheduling Algorithm

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ABSTRACT: Data centre hosting cloud applications consume huge amount of electrical energy, contributing to high operational costs and carbon footprint to the environment. Until recently, high performance has been the sole concern in data center deployments and this demand has been fulfilled without paying much attention to energy consumption. An average data center consumes as much energy as 25,000 households. As energy costs are increasing while availability dwindles, there is a need to shift the focus from optimizing data center resource management for pure performance to optimize them for energy efficiency, while maintaining high service level performance. There is also increasing pressure from the government worldwide aimed at the reduction of carbon footprint, which has significant impact on the climate change. Thus providers need to minimize energy consumption of cloud infrastructures, while ensuring the service delivery.

KEYWORDS: Carbon footprint, VM Migration, Energy Monitor, QOS, VM

I.INTRODUCTION

Cloud computing is the latest evolution of computing, where IT capabilities are offered as services. It is a model in a Pay-As-You-Use manner. Cloud computing, the long-held dream of computing as a utility, has the potential to transform a large part of IT industry, making software more attractive as a service. Based on a pay-as-you-use model, it enableshosting of pervasive applications from consumer, scientists and business domain. Lowering the energy usage of data center is a challenging and complex issue because computing applications and data center are growing so quickly [4]. Cloud computing with increasingly pervasive front-end client devices interacting with back-end data centers will cause an enormous escalation of the energy usage.Clouds are virtualized datacenters and applications offered as services on a subscription basis. They require high energy usage for its operation. Today, a typical datacenter with 1000 racks need 10 Megawatt of power to operate, which results in higher operational cost [4]. Thus, for a datacenter, the energy cost is a significant component of its operating and up-front costs. According to a report published by the European Union, a decrease in emission volume of 15%–30% is required before year 2020 to keep the global temperature increase below 2 C. Thus, energy consumption and carbonemission by Cloud infrastructures has become a key environmental concern [2].

II. VIRTUALIZATION IN CLOUD COMPUTING

The key concept of cloud computing is virtualization. Virtualization technology allows multiple operating systems run concurrently on the same physical machine. Virtualization technologies have a host program called "Virtual Machine Monitor" or "Hypervisor", which is a logical layer between underlying hardware and computational processes and runs on the top of a given host. It can run multiple operating systems concurrently. It provides facility to migrate virtual machine from one host server (source) to another physical host server (destination). A virtual machine is a software implementation of a computing environment in which an operating system or program can be installed and run along with the applications.Virtual Machine Migration (VMM) is a useful tool for administrators of data center and clusters; it allows clean separation between hardware and software [1]. VMM enables energy saving, load balancing and efficient resource utilization and resource fragmentation. VMM avoids residual dependencies. In Cloud computing, applications, server and network devices can be virtualized. The two types of Virtual Machine Migration are hot

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migration (Live Migration) and cold migration (Non-Live Migration). In hot migration, the VM keeps running while migrating and doesn't lose its status. User doesn't feel any interruption. In cold migration, the status of VM loses and the user can notice the service interruption [1].

III. EXISTING MODEL

In existing system, 90% of the servers in the data centers remain idle most of the time performing nothing but consuming huge power and emitting enormous amount of heat and carbon[4].In existing system, the live virtual machine migration also causes performance loss and energy overhead which costs high. In virtual machine migrations, the communicating VMs may be hosted on distant physical nodes leading costly data transfers. The network communication may involve network switches that consume significant amount of energy [1]. Although, Virtual machine migration cannot provide quick migration with low network overhead but leads to large performance degradation of Virtual Machine services due to great amount of transferred data during migration.
The drawbacks of the existing system are as follows:

- The usage of electrical energy is more.
- Emission of carbon footprint is very high.
- Spending more cost for cooling systems.
- Efficient resource utilization is not considered much as expected.
- Load balancing and energy management causes excess energy and cost.

3.1 Energy aware resource allocation

The objective is to improve the energy efficiency of data center while delivering the negotiated Quality of Service (QoS)[1].The methodologies include

- Modified Best Fit Decreasing (MBFD) algorithm
- Minimization of Migration algorithm
- CloudSim toolkit.

The advantages are the reduction of energy consumption costs and also utilized resource allocation algorithm for energy consumption. The disadvantages are that they haven't investigated the problem of combining different workload types. The optimization of the algorithm is slow due to complex computation. The future work should extend the work to develop a software platform that supports the energy efficient management and allocation of cloud data center resources.

3.2 Computing Performance of Data Center

The objective is to identify and implement energy efficiency and green computing performance metrics in dada center. The Power Usage Effectiveness metrics is used. The advantages are the demonstration of the Power Usage Effectiveness is clearly explained. The disadvantages are the performance of data centers is less and also the performance and cost are the major attributes for energy consumption. The future work should develop a vital tool for power and energy consumption[4].

3.3 Energy efficient Virtual Machine Live Migration:

The paper presents a review of research work done by researchers based on energy-aware virtual machine live migration.
The observations made are as follows:

- Inefficient use of computing resources.
- Low server utilization.
- 70% of the servers in a single data center remain idle consuming huge energy.

The future work is to develop energy efficient optimized live Virtual Machine migration policy to minimize energy overhead. Achieving a full trade-offbetween performance and energy efficiency is a challenging research. One should analyse the energy consumption of various subsystems.

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3.4 Investigation into the Energy Cost of Live VM migration

The paper investigates the energy consumption and service execution latency during virtual machine migration. The methodologies used are KVM, libvert and pre copy phase virtual machine migration[3]. The observations are as follows:

- Power consumption of both the source and destination during migration is high.
- VM migration time was affected by the size of the VM.
- The migration time decreases as the network bandwidth decreases.

3.5 Cost of Virtual Machine Migration in Clouds

The paper presented a performance evaluation on the effects of live migration of virtual machines. The methodologies are Xen VMs and multi-tier web 2.0 applications. The observations made are as follows:

- Live migration causes a significant downtime.
- Considerable amount of service disruption causes in some situations.
- Though there is a downtime during live migration, 99% of SLA was met.

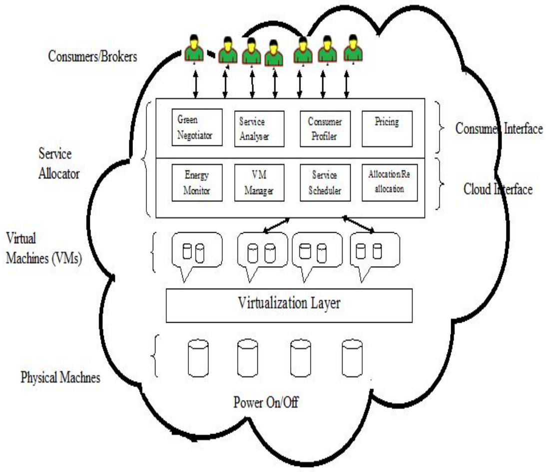
IV. PROPOSED SYSTEM

The two possible solutions to save electrical energy is improving efficiency and finding a plentiful supply of clean and renewable energy. Virtual Machine migration can increase efficiency by placing the virtual machine where there is a huge amount of renewable energy is available. In a Data center, not all the servers are full used, mostly 90% of the servers are idle performing nothing but consuming huge amount of heat and energy so switching off the idle servers can save power and emission of heat and carbon.

The placing of virtual machines should be efficiently done so that we can reduce the communication network which reduces energy consumption. Though with the live Virtual Machine migration, the performance degradation and energy overhead due to low network bandwidth may indirectly causes energy consumption cost. To reduce the performance degradation and energy overhead in the virtual machines, we should develop an efficient technique for virtual machine migration in Cloud data centers.

The advantages of the Proposed System are as follows:

- Can reduce the carbon footprint to the environment.
- Reduce the electrical energy consumption by finding clean energy.
- Can reduce the cost for cooling systems.
- Efficient resource utilization is considered.



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The System architecture supports the energy-efficient service allocation in Cloud Computing infrastructure. The four major components are discussed in this project is Energy Monitor, VM Manager, Service Scheduler and VM Allocation/Re-allocation.

4.1 Users/Consumers Module:

This module is designed to service the request submitted by the cloud users or Cloud consumers anywhere in the world. This module is solely designed to service the consumers request what are they requested. The users can request any type of request according to the user's needs.

4.2 VM Manager Module:

This VM Manager Module tracks the availability of the Virtual Machines. It also monitors the resources which is available for a Virtual Machine. It allocates the Virtual Machine to service the particular request. The VM manager module decides which virtual machine to allocate and reallocate. It also makes decision which machine to allocate for the request provided by the users.

4.3 VM Re-Allocator Modules:

This Re-Allocator module is designed to allocate the VM which is consuming renewable energy or low electricity consuming VM. When the machine is consuming huge amount of time or the request is getting delayed or the too many request is being in the queue, the virtual machine is reallocated according to the user's request.

4.4 Energy Monitor:

This module monitors the energy consumed by each VM which is allocated to perform the task. The energy monitor also monitors the whole server's electrical energy so that the VM Manager can use of renewable energy that is provided by various sources.

V. CONCLUSION AND FUTURE WORK

To minimize the electrical energy consumption and carbon emissions to the environment, several energy efficient techniques were proposed. In this work, an algorithm called Job Shop Scheduling algorithm is implemented so that there is a considerable reduce in electrical energy consumption and also the carbon emission. There are too many scheduling algorithms for the minimization of the electrical energy and also the carbon emissions. Since we have designed Job Shop Scheduling algorithm which is a NP-Hard problem where we have too much solution space so we can reduce the electrical energy consumption to some extent.

Our work should be extended to setup the cloud environment in real world so that the algorithm implemented will give better result than any other scheduling algorithm. Since there are too many scheduling algorithms, there is a need to develop a software platform which reduces the total data centerelectrical energy. Since an effective algorithm which handles a huge data center must be developed. Though the algorithms developed may be effective in their own terms but that is not sufficient to handle a huge data center.The future should also extend the work on implementing more effective algorithm for better results of energy consumption and also the reduction of carbon emissions to the environment. The researchers should also extend their work to develop a software platform which concerns energy reduction.

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