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A Review on Energy Efficient Techniques in Green Cloud Computing

[1]Pragya, [2]Manjeet Gupta
[1]M.tech [Computer Science] Student, Department of Computer Science Engineering, Seth Jai Prakash Mukand Lal Institute of Management and Technology, Yamuna Nagar Haryana, India
[2]Assistant Professor, Department of Computer Science Engineering, Seth Jai Prakash Mukand Lal Institute of Management and Technology, Yamuna Nagar, Haryana, India

Abstract—Green Cloud Computing is approach used to improve the utilization of computing resources those we are using in cloud computing network such as servers, storage, its applications, and services and reduce energy consumption of these resources which improves power efficiency. This is done by various technologies such as virtualization and virtual machines migration; Virtualization technology improves power efficiency of data centers by enabling the assignments of multiple virtual machines (VMs) to single server and Virtual Machines (VMs) Migration is done to balance load under each server. The main objective of this review is to study and analyze the concept of various techniques of Power and performance Management, Resource Management, Energy Efficient Data Center Architecture and Resource Allocation and Optimization.

Keywords: SLA, VMM

I. INTRODUCTION

Cloud computing is a model that enables convenient , ubiquitous and on-demand network access to a shared pool of configurable computing resources (like networks, servers, storage, its applications, and services) that can be speedly provisioned and released with minimal management effort or service provider interaction. Cloud computing achieve multi-level virtualization and abstraction through effective integration of variety of computing, storage, collection of data, applications and other resources, user-friendly to use powerful computing and Storage capacity of cloud computing only need to connect to the network. The cloud computing has made situation far better .With cloud computing virtual network, the capability of handling millions of users becomes easy. These characteristics have attracted many IT giants like Amazon , Google ,Microsoft , Intel, VMware etc. Amazon is currently providing two services first Amazon S3 a Simple Storage Service and Amazon EC2 Elastic Cloud Computing. Therefore a lot of new applications are deployed on internet every day and numbers of people using these services are growing rapidly. The increase in demand of new users for accessing applications in public and personal level. Personal level like social networking which produce a huge work load and public level includes private corporations and public organizations. To manage load technology like virtualization had evolved which had made computing more compelling than previous years.

It has been observed that the consumption had been doubled since year 2000. These of surveys has given birth to a new advocacy called green computing which is growing with the aim to make the system energy efficient and efficient utilization of resources. Studies shows average utilization of data centers can be nearly 20% and energy consumed by the idle resources is can be as much as 60% of the peak power.

Virtualization technology improves **power efficiency of data centers** by enabling the assignments of multiple virtual machines (VMs) to single server. The assignment of multiple VMs helps in consolidating the task and turning off other physical machines there by lowering the consumption of energy. Another way for green computing is through service level agreement SLAs which is established between the service provider and the consumer before allocation of infrastructure. The SLA could be related to storage space, bandwidth, and power consumption. On basis of performance SLA could be related to service time and Quality of Service.

Virtual Machine Migration is another green computing technique for efficient usage of resources. The VMM technique migrate virtual machines from one machine to another this will help in distributing load from one physical machine to another. After the CPU utilization decreases it will migrate the VM back to the machine and turn off the second machine. This helps in lowering the electricity consumption by physical machines. Since the machine will consume energy when required else it is turned off. VMM could be done by using different algorithm like first fit ,monte carlo, round robin etc.

II. CLOUD COMPUTING ARCHITECTURE

The **cloud architecture** broadly has two blocks the front end and back end. Both of them are connected to each other through network. The front end includes the user computer and the application required to access the cloud computing system. Every cloud computing systems do not have the similar user interface.

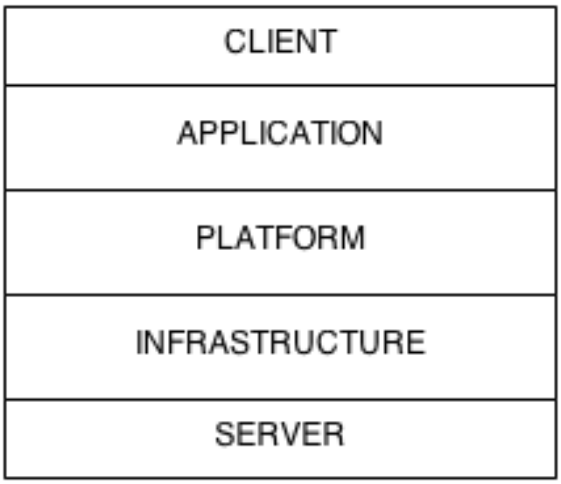

Figure 1: Architecture of cloud computing

Back end of the system includes various computer systems, servers and data storage systems that create the "cloud" of computing services. A central server administers and heads the system, monitoring traffic and client's demands to ensure everything runs perfectly and smoothly. It follows a set of rules i.e protocols and uses a special kind of software known as middleware. Middleware allows computers that are networked to communicate with each other. If a cloud computing company has a lot number of clients, there will be a high demand for a lot of storage space. Some companies require hundreds to thousands of digital storage devices. Cloud computing systems need minimum twice the number of storage devices it requires to keep all its clients' information stored. A cloud computing system must make a copy of all its clients' information and store it on different devices. The copies enables the central server to access any backup machine to retrieve data that otherwise would be unreachable. Making copies of data as a backup is redundancy.

III. LITERATURE REVIEW

A) VM-based energy-efficient data centre architecture

Author proposed [5] data centre architecture for cloud computing, as in figure below.

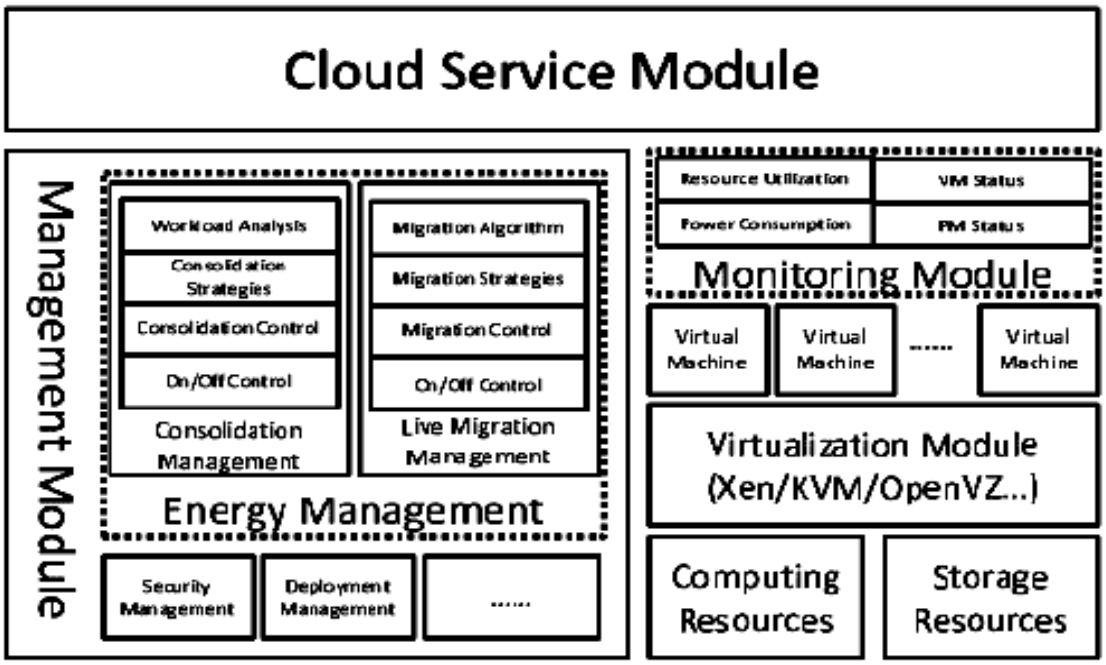

Figure 2: Green Cloud Architecture

The architecture basically has four main modules: Virtualization Module, Monitoring Module, Management Module and Cloud Service Module.

a) **Virtualization module** is an abstraction layer that shields heterogeneous physical resources and provides dynamical, scalable virtual resources to users on demand.

b) **Monitoring module** is responsible for monitoring both virtual machines and physical machines; including resource utilization, power consumption and virtual machine status, etc.

c) **Management Module** implements all the management issues in the data centre cloud, including Energy Management Sub module, Security Management Sub module and Deployment Management Sub module etc

d) **Cloud Server Module** plays an important role in cloud computing that in which all the resources are provided to the users with services via Internet.

B) Decentralized architecture of resource management

Issues like in sufficient cooling system which leads to reducing system reliability and devices lifetime are discussed [**4].** The author presents decentralized architecture of resource management in which there are three layers called dispatcher, global manager and local manager. The local manager looks after the CPU utilization and thermal state. Any of the feature is tend to gets violated the local manager inform the global manager. The different conditions are when CPU utilization is near to 100%, under utilization of resources and high temperature. The decentralization removes single point failure and improves scalability. Moving towards allocation policies it had divided the VM reallocation in two parts firstly selection of VM to migrate, secondly determining new placement for these VMs on physical node.

C) Simulated Annealing Optimizing Technique

Cloud computing aims to offer utility based IT services by interconnecting large number of computers through a real-time communication network such as the Internet. There is already a significant increase in the power consumption by the data centers that host the Cloud applications because of the growing popularity of Cloud Computing in more and more organizations involved in various fields. Hence, there is a need to develop solutions that aim to save energy consumption without compromising much on the performance. Building such solutions would not only help in reducing the carbon footprint but would also cut down the costs without much compromise on SLA violations thereby benefiting the cloud service providers. In this paper **[7]**, Simulated Annealing Optimizing Technique has been used for the purpose of continuously optimizing the placement of the VMs (Virtual Machines) over the hosts in order to minimize the power consumption hence providing cost benefits to the service provider. The results make it clearly proof that by using virtualization at the data centre level and optimizing the virtual ly done resource allocation could significantly reduce the power consumption by the servers.

D) Scheduling of virtual machines for Energy efficiency

There is a great demand of powerful data centers (DCs) because high performance cloud computing is required in every field such as business and web applications. These DCs uses huge amount of power and emits large amount of CO2 and heat in the environment. CO2 cause green house effect and to make the environment eco friendly, energy efficient cloud computing is required. To decrease the power consumption , if the size of DCs is minimized then performance is compromised and SLA violations takes place, so to get creditable performance plus less power consumption green cloud computing approach is followed**[8]**. There are different algorithms that decrease the power consumption with the help of virtualization and energy efficient scheduling of virtual machines.

E) Routing according to geographical distance

This infrastructure provide services to traffic that can come from anywhere in this world. It is needed, for latency purposes, to move/pass the traffic to the data center that is closest as geographical distance, costs the minimum power, and emits the smallest amount of co2 for a given request. It is not possible to achieve all of these goals every time , so we have modeled both the networking and computational components of the infrastructure as a graph to determine which data center requests should be firstly routed based on the priorities of the cloud operator.

Paper title with reference No.	**Proposed techniques**	**Virtualization**	**Goal**	**Limitations**
Power and Performance Management of Virtualized Computing Environments via Lookahead Control **[1]**	DVFS, VM consolidation, server power switching	Yes	Reduce power consumption, To minimize performance loss	Processing rate of Virtual Machines with different CPU Share must be predefined or known.As model is complex, the optimization controller execution time is high.
Multi-Tiered On-Demand Resource Scheduling for VM Based Data Center **[2]**	Resource throttling	Yes	To Maximize the resource utilization, fulfil performance requirements	Optimization is of only CPU and No other resource. Resource need should be known before work i.e advance
GreenCloud: Energy Efficient and SLA-based	Leveraging heterogeneity of Cloud data centers	Yes	Minimize energy consumption, satisfy performance	Aggressive and high VM consolidation leads to

Management of Cloud Resources**.[3]**	,Green resource allocator, DVFS		requirements	performance degradation and SLA violations.
Energy Efficient Resource Management in Virtualized Cloud Data Centers. **[4]**	Optimization over multiple system resources, network optimization and thermal Optimization. Local and Global managers for VM placement and continuous Optimizations.	Yes	Minimize power consumption and handle strict QoS requirements	Real implementation on a system not possible and also experimental Evaluation.
Virtual Machine Based Energy-Efficient Data Center Architecture for Cloud Computing: A Performance Perspective. **[5]**	Server consolidation, live Migration.	Yes	Minimize energy consumption through efficient server consolidation and live VM Migration.	Lacks a concrete solution to reduce Energy consumption.
Energy Efficient Allocation of Virtual Machines in Cloud Data Centers. **[6]**	Effective dynamic relocation of VMs, Minimization Migration, Highest Potential Growth, Random Choice, DVFS	Yes	Minimize power consumption, satisfy performance requirements	Considers CPU only as a resource and not disk storage, network bandwidth as they also consume significant amount of power.
Green Cloud: Smart Resource Allocation and Optimization using Simulated Annealing Technique**[7]**	Simulated Annealing Optimizing Technique, Minimum Utilization, Maximum Utilization, Minimum Migration Overhead, Random Choice	yes	Reduce power consumption, remove idleness	The requirements should be known in advance for initial allocation to take place. This information may not be known in maximum scenarios.
A Review On Energy Efficient Cloud Computing Algorithms[8]	Exact VM Allocation, Combination of allocation and migration algorithms, Sorting VMs and PMs to Minimize the use of PMs, Energy Aware Migration Algorithm	yes	Exact VM Allocation cost of allocation is reduced and in Exact VMs Migration cost of migration is reduced.	Constraints are added with every algorithm which makes it inflexible.

IV. CONCLUSION

Cloud computing has grown so fast that it had made almost every organization rely on it. Since the time it had developed and now there is vast technological change in the field. It requires huge effort to build a technology that could help consumers as well as service providers. Currently we are facing energy as a challenge in the field because due to steep increase in demand the deployment of hardware infrastructure is being deployed at pace. This infrastructure not only consume electricity by itself it also need auxiliaries which also consumes electricity in order to keep the temperature down for these machines. The consumption of energy varies a lot and moreover we saw two abnormalities as task rejection by data center and task failed on servers which is an issue. we can formulate strategies to minimize the power consumption, better task allocation policies in future for fine utilization of resources.

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