Analysis of LrMu Power Algorithm in the Cloud Computing Environment using CloudSim Toolkit

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Abstract- Cloud computing has become a new IT platform for online services like storage, CRMs and development platforms and many more. All these services are full filled by Service level Agreement. As the cloud provides us many features but it also has many disadvantages also, one of them is power consumption. Cloud computing data centers consumes a lot of power. To reduce the power consumption many algorithms are proposed, one such algorithm is LrMu algorithm. In this paper we discuss and analysis this algorithm and also compare it with few of other similar type of algorithms.

Keywords- LrMu, Local regression, Minimum utilization, Cloud computing, DVFS, Non-power aware, ThrRs, IqrMc, MadMmt, Power consumption.

I. INTRODUCTION

Cloud computing has become a new IT platform for providing and accessing online services on pay as you go model. Clouds are large groups of fundamental resources which can be accessed and used anytime, anywhere just using an internet accessible device like computers, desktops, mobiles. As the cloud computing technique is growing many problems are getting reported. Some of the problems are performance, cost, power, security, management of resources etc. These problems are discussed below:

1. **Performance:** Performance of a cloud computing system is the ability to process any performing function or task. No cloud service provider can assure 100% performance. Also the performance is depends upon internet speed of user also as all these services are online and require internet.
2. **Cost:** Cost of using and accessing cloud is very low but the cost of establishing a cloud computing groundwork is very high as one single cloud datacenter contains thousands of systems at one place.
3. **Security:** Security of cloud is provided by the CSP but the security is not complete. As the systems are not completely safe from any cyber-attack.
4. **Management of Resources:** Management of resources are not easy in cloud as the cloud services are growing rapidly and keeping resources according to the increasing demand is not easy.
5. **Power Consumption:** Enormous amount of power is consumed by these resources because most of these systems doesn't work on their full capacity. In a research it was found that most of these systems are working on 70-60% of their max power and most of these systems are ideal in state.

Main entities of cloud bionetwork are as follows:

1. **Cloud Consumers**: These are the service users who uses the cloud services that are being provided to them.
2. **Cloud Services**: Cloud services are the support that is provided by the cloud service providers to the cloud consumers. For example: development platforms, storage, etc.
3. **Cloud Service Providers** (CSP): Cloud Service Providers are the workers who provide cloud services to the cloud consumers on pay as you go model.

Services offered by the CSPs are as follows:

1. **Platform as a Service** (PaaS): PaaS is a cloud service that is provided by the CSP these services include providing development environment for development & testing of a particular system, provides DB, networks etc.
2. **Infrastructure as a Service** (IaaS): IaaS is a service which is quick in nature and managed over the internet. As these services can be accessed on one click. We just need to pay the price and we can access these services. This reduces cost of buying the physical servers. For example customer network, storage etc.
3. **Software as aService** (SaaS): SaaS is a service which relates to the software's which are provided by the CSPs over internet and on the bases of subscription. For example the email service, CRM service, etc.

II. RELATED WORK

1. The scheme proposed in [1] defines the power consumption algorithms study. In this paper non-power aware and DVFS algorithms are considered and analyzed. The comparative study of these algorithms are mentioned in the paper. Experimental result shows that DVFS is a better power algorithm then non-power aware algorithm.
2. The scheme proposed in [2] addresses the energy consumption problems using DVFS algorithm as a base for gaming data center load. Simulation tool used is CloudSim for the implementation. Experimental result shows that DVFS is a better algorithm to be used for the gaming load.

3. The scheme proposed in [3] is that the paper proposes a new algorithm for energy consumption throughout VM migrations. The proposed algorithm is experimentally more fast then the compared algorithms. Some algorithms compared are Single Threshold, DVFS, Minimum migration policy etc.
4. The scheme proposed in [4] is a comparative study upon the VM provisioning techniques & offered the relative study. The simulation is done using CloudSim toolkit.
5. The scheme proposed in [5] is that a new algorithm is been proposed namely heuristic energy-aware algorithm. The goal of this algorithm is to minimize energy consumption and check for less SLA violations.
6. The scheme proposed in [6] is that a comparative study has been conducted on VM allocation threshold of their usage. CloudSim has been used as tool kit to conduct the study. IQR is the result of this study as best algorithm.
7. The scheme proposed in [7] is that this paper lists all the tools that are required to execute a simulation that support energy ware investigation. Main focus of this paper is DVFS technique.
8. The scheme proposed in [8] is in the paper DVFS & VM consolidation is been carried out in brief. A new algorithm named Brownout is been proposed. Result of research is that proposed algorithm is better than DVFS.
9. The scheme proposed in [9] is that paper proposes a new method to reduce energy waste and also this paper explains the reasons for energy wastage. Results shows that the proposed method is 24% better than existing methods.
10. The scheme proposed in [10] is that the migration time of VM are explained & methods for reduction of it are proposed. The study is conducted in CloudSim & experimental results shows that the method actually reduced migration time as compared to MadMmt.

III. LIST OF ALGORITHMS

1. **DVDS:**DVFS means Dynamic Voltage & Frequency Scaling. This algorithm uses Dynamic Voltage VM allocation policy and Frequency Scaling VM selection policy to save energy in surrounded systems along with mobile devices. This an entirely different technique like it reserves power and also put the systems to hibernate mode to save energy. All these are very helpful. It lowers the frequency and voltage of connected peripherals & processors.
2. **Non-power aware:** Power Data Center Non power aware is a datacenter knowledge class inside the situation of power aware simulations. This knowledge center tells us that all hosts will uses maximum power entire time.
3. **IqrMc:** IqrMc means Inter Quartile Range Maximum Correlation. This technique consists of Inter Quartile Range (IQR) VM allocation policy which is allocation of VM in cloud system method & Maximum Correlation (MC) VM selection policy. IQR = Q3-Q1, this is almost similar to (MAD) Mean Absolute Deviation. The MC policy is established on the concept that is the upper the correspondence in between the resources usage by apps running on an oversubscribed servers.
4. **ThrRs:** ThrRs means Static Threshold (THR) Random Selection (RS). This is based on the concept of Static Threshold VM allocation Policy & Random Selection (RS) VM selection policy. This technique is constructed to monitoring CPU usage of a host, if the usage falls under the set minimum threshold then the VMs will be reassigned to the different node. The left host will be put to sleep or low energy mode to save energy. If the utilization increased the maximum threshold then the VMs will be reassigned to the different node. It can use different VM selection policies also like HPG, ST, MM, RC, etc.
5. **MadMmt:** MadMmt means Median Absolute Deviation Minimum Migration Time. This technique uses Median Absolute Deviation (MAD) VM allocation policy and Minimum Migration Time (MMT) VM selection policy. The MAD is an amount of analytical distributions. It's a good expert of gauge than the classical variance. It is calculated as MAD = median($|x_i$ – median(x_i)|);

LrMu Algorithm

LrMu means Local Regression (LR) VM allocation policy & Minimum Utilization (MU) VM selection policy. MU is a VM selection policy that selects the VM for migration with minimum Utilization of CPU. LR is a VM allocation policy that uses local regression to predict host utilization load and check if the system is overloaded or under loaded. This algorithm uses 1.2 as a safety parameter. The safety parameter is used to limit the consumption of power and check for SLA violation.

Analysis of LrMu algorithm

Algorithms	Energy Consumed in Kwh	Number of VM Migrations	Number of Host Shutdown
Non-power aware	150.68	0	29
DVFS	52.98	0	29
ThrRs	40.97	4302	1367
IqrMc	46.86	5085	1517
MadMmt	45.61	5265	1528
LrMu	35.38	2808	816

Table 1: Comparative Analysis of power consumption algorithms

Flow Chart of LrMu

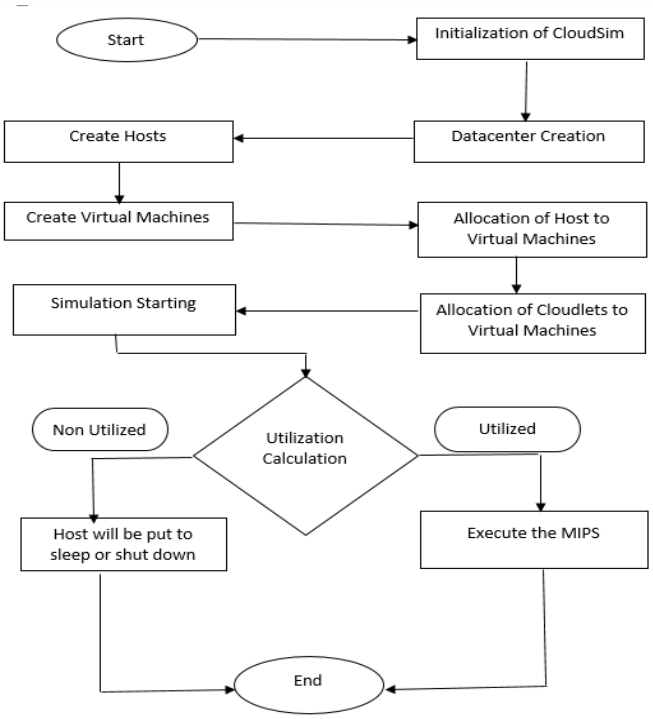

Fig.1: Flow Chart of the LrMu datacenter

Steps of Implementation

Step 1: **Initialization:** CloudSim package is initialized first in the step 1.

Step 2: **Build Datacenter:** The datacenter are formed when the hosts are formed. The no. of hosts differ with the simulation of datacenter.

Step 3: **Build Hosts:** The host are formed within the datacenters. This category is inside the CloudSim package. Every host need to the plan quantity of processors and their MIPS rating.

Step 4: **Build VM:** VM category is used to create VMs. This category accepts the list of VMs. Each VM in the system has some provisions like RAM, Bandwidth, MIPS, etc.

Step 5: **Allot hosts to VM:** Once the VMs & hosts are build. VMs gets allotted to hosts. The VM arrangement is stated while production of host. The VM arrangement on host can be TimeShared or SpaceShared based on the policy obtained.

Step 6: **Allot cloudlets to the VM**: Cloudlets get allotted to the VMs.

Step 7:**Initiate Simulation:** Once the whole allocations are completed, the simulation gets started. startSimulation() function is provided by the CloudSim package for this resolution. Time frames are defined for every frame before starting of simulation.

Step 8: **Calculate Utilization:** Utilization can be calculated for every time frame. If the demanded MIPS is bigger than the total assigned MIPS then the host is overloaded. Whereas if the demanded MIPS is lesser then the total assigned MIPS then the host is under loaded.

Step 9: **Host with no utilization**: The host will be put to sleep mode so as to save energy and optimize the efficiency.

Step 10: At the end of simulation, CIS notify to the entire cloud entities to shut down. The whole energy consumption by the datacenter & no. of host's shutdown are considered. No. of VMs migrations are also considered. Performance degradation is also considered.

IV. CONCLUSION

All the algorithms are executed in the CloudSim toolkit namely Non-power aware, DVFS, IqrMc, LrMu, ThrRs, and MadMmt. By the above table calculations we can conclude that LrMu is the best technique which uses less energy and less amount of VMs are migrated and less amount of VMs are shutdown. At the overall calculations this technique reduces energy by approximately 77% as compared with the algorithms.

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