Energy Efficient Load Balancing Approach to Increase Security in Cloud Infrastructure

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Abstract- Cloud computing is an emerging paradigm of business computing infrastructure viable information on the Internet that can be accessed from a Web browser by customers to meet their needs. In Cloud computing , when large number of requests arrive at cloud data centre some of the hosts get overloaded. To balance the load among cloud data centre, we are using load balancing concept. This paper proposes distributed cluster head energy efficient dynamic VM Consolidation algorithm for reducing energy consumption and minimizes number of VM migration while keeping SLA violation at low level. In this work, Cloudsim is used for performing simulations.

Keywords- Cloud; Virtual Machine; Load balancing; Cluster head, Server clustering.

I. INTRODUCTION

The cloud computing is pay-per use model. Resources can be accessed on-demand by everyone from anywhere, anytime via internet on paid basis. The cloud is measured by a group of resources available in the system, including hardware such as CPU, memory, storage and software size. In addition to these, resources from other computing resources are available. These resources are used to provide end-users, consumers. This service is available regarding service plans. The key concept of the application of cloud computing is to reduce the economic burden on computing resources, to develop and maintain these services the cloud service provider can apply rent on consumers. Although most of the cloud service is the responsibility of the manager of cloud to provide the resources requested by end users as soon as possible in an organized and efficient manner[1].

It seems that the manager should cover up with several problems with the problem of load balancing as one of the crucial. Cloud Manager has the ability to take design reduce complexity and make it easier. Cloud Manager charges different users that need shared resources. These resources are available in this approach so that the power requirements and latency should be minimized. The task to optimize one level of the architecture seems to be difficult when you operate at multiple levels as part of the planning of the load, queue management, resource allocation, management of food etc [2].

Cloud computing is a standard due to which computing is moving away from personal computers and even the application of an individual computer server to "cloud" of a company. A cloud is a group of virtual servers that can provide different computing resources to their clients. A user of this system does not have to worry about IT demand. The underlying details of how it is achieved are hidden from the user. Data and services can be found in highly scalable data centers and can be accessed from any connected device in the world ubiquitously.

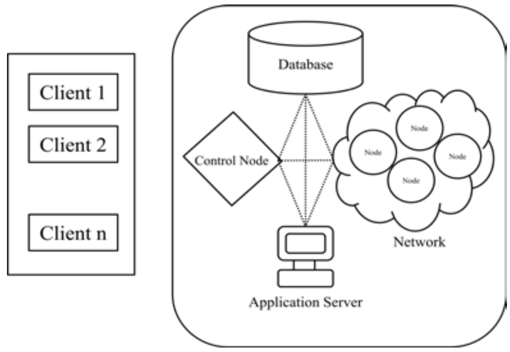


Figure 1: Cloud Network

Cloud computing is a style of computing where massively reduced IT related capabilities are provided as a service over the Internet to multiple external customers and billed by consumption. Many cloud providers have emerged and there is a considerable growth in the use of this service. Google, Microsoft, Yahoo, IBM and Amazon have started offering cloud services. Amazon is the pioneer in this field. Small companies like SmugMug, a photo hosting site online, use the services of the cloud to store all the data and make a part of their services.

Cloud Computing is finding use in various fields such as web hosting, batch processing in parallel graphics processing, financial modeling, web mining, the analysis of genomic, etc

II. LOAD BALANCING

In general, load balancing [4] provides the ability to avoid the situation where some resources are overloaded while others remain idle or under loaded. Load balancing aims to optimize resource use, maximize throughput, avoid overload and minimize response time of any single resource. This section provides a summary of the work related to load balancing techniques. Specifically, the main features are described in a wide range of approaches to load balancing.

Load balancing [4] is the process of reallocation of the total expenses of the individual nodes of the collective system, to gain a better response time and also a good use of resources. Cloud computing is an Internet computing in which load balancing is one of the difficult tasks. Several methods are used to make a better system that affect the loads on nodes in a balanced way but due to network congestion, use of bandwidth, etc, problems occur. These problems are solved by some existing techniques. A load balancing algorithm does not consider the previous state of the system and dynamic in nature. It depends on the actual behavior of the system. There are several objectives related to load balancing to improve performance significantly, to maintain system stability, etc. According to the current state of the system, algorithms of load balancing can be classified into two types, which are static algorithms and dynamic. The static algorithm depends on the priori information of the system and does not depend on the current system. In the case of dynamic algorithm, this is based on the current system, and is more efficient than the static algorithm.

III. ENERGY EFFICIENT DYNAMIC VM CONSOLIDATION

This paper proposes an Energy Efficient Dynamic VM Consolidation algorithm for reducing energy consumption and minimizes number of VM migration while keeping SLA violation at low level. In this technique, efficient allocation of requested virtual machine on the physical machine is done which minimizes the allocation time of VM and provide the efficient utilization of resources with load balancing and server consolidation techniques.

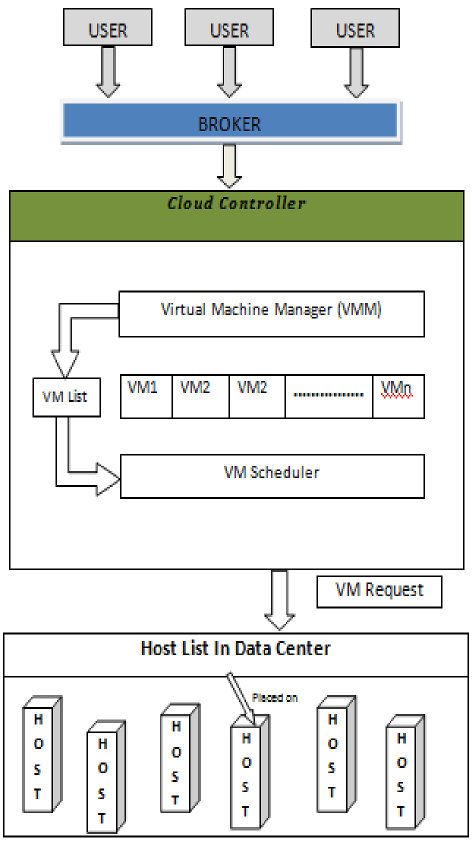


Figure 2: Frame Work for Proposed Scheme

The virtual machine manager passes the list of VMs to VM scheduler. Now there is problem of mapping the VM request to the physical machines in the cloud datacenter. VM scheduler select one VM from the VM list and allocate on the first satisfying physical host even if other hosts remain underloaded. Host list in data center maintain list of all host available in cloud data center. Host consists of multiple VM, to run multiple tasks at a time. Total VM resource allocation should not exceed the host capacity. Figure 3.1 below shows the model for virtual machine placement to host list present in the datacenter.

IV. METHODOLOGY

A. Inter quartile Range (IQR) method for finding dynamic threshold

The inter quartile range (IQR) is an estimation of variability, based on isolating a data set into quartiles. It is the difference between the upper and lower quartile in a data set.

Steps for finding Inter quartile Range:

- Arrange the data set in increasing order.
- Find the median for the ordered set (Q2).
- Divide the data set into two halves.
- Find the median for the first half of the ordered data set (Lower Quartile Q1).
- Find the median for the second half of the ordered data set (Upper Quartile Q3).
- IQR = Upper Quartile – Lower Quartile. Here data set describes set of the host utilization. We propose a method based on two threshold value, upper threshold and lower threshold. The median for the first half of the ordered data set (host utilization) s used to compute the lower threshold value, while median of second half of the ordered data set (host utilization) is used to compute the upper threshold value. This is shown in example as follows:

Let us assume the utilization of every host (in terms of percentage).

List of host utilization [23,65,10,75,50,84,15,30,90,12]

- After sorting [10, 12, 15, 23, 30, 50, 65, 75, 84, 90]
- Median = (30+50) / 2 =40
- First half [10, 12, 15, 23, 30], Second half [50, 65, 75, 84, 90] After selection of VM from VMmigrationList1 check best suitable host from Most Likely Over loaded Host List and if its utilization after allocation is greater than previous utilization on the host along with power after allocation (Power after Allocation) less than min Power then select this host for VM migration.

In algorithm 2, we replace host list by Most Likely Over loaded Host List which is defined as follows

Algorithm 1: VM placement algorithm for Overloaded Host

For each VM in VMmigrationList1

{

For each Host in Most Likely Over loaded Host List

{

If (this host is suitable for VM)

{

Calculate utilized After Allocation;

Calculate power After Allocation;

If ((utilized After Allocation > previous utilization on the host)

&& (Power after Allocation < min power))

Target Host = this Host

}

}

Add (VM, Host) pair to Migration Map

}

Algorithm 2: For finding Most Likely Over loaded Host List

or each Host in descending order of capacity

{

If (lower Threshold< host Utilization< upper Threshold) Add (host) to Most Likely Over loaded Host List;

}

B. Under loaded host detection and server consolidation

In case of underutilization, energy wastage is more because servers typically need up to 70 % of their peak energy even at their low utilization level. So there is a need of VM migration technique which consolidates VM to the minimum number of servers for reducing energy consumption. Lower threshold is used to detect whether host is under loaded or not. Hst utilization is form eq. (1).If host utilization is less than lower threshold then it s considered as under loaded. Then all the VM of this host are selected to migrate to other host by applying server consolidation technique and this host is switched to idle mode [36].

In this algorithm, VM migration List (VMmigrationList2) contains all VMs from under loaded host then checks suitable least loaded host from Most Likely Under loaded Host List. Where “utilized After Allocation” means utilization after allocation, “previous Utilization on This Host” means preceding utilization on this host.

Algorithm 3: VM placement algorithm for Under loaded Host

For each VM in VMmigrationList2

{

For each Host in Most Likely Under loaded Host List

{

If (this host is suitable for VM)

{

Calculate utilization After Allocation;

Calculate power After Allocation ;

If ((utilization After Allocation > previous Utilization on This Host)

(power After Allocation < min power)) {

Target Host = this Host

}

}

}

Add (VM, Host) pair to MigrationMap

}

Apply the server consolidation

}

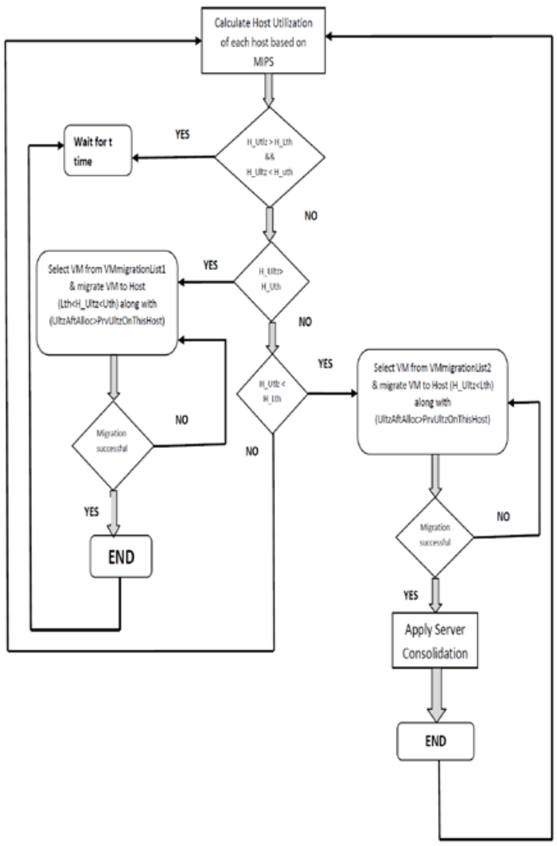


Figure 3: Work flow of the VM Placement algorithm

In algorithm 4 we replace host list by Most Likely Under loaded Host List which is defined as follows

Algorithm 4: For finding Most Likely Under loaded Host List

For each Host in data center

{

If (host Utilization < lower Threshold)

Add (host) to Most Likely Under loaded Host List;

}

V. ENERGY EFFICIENT DYNAMIC VM CONSOLIDATION: PROPOSED ALGORITHM

Input: VM migration List1, VM migration List 2, Most Likely Over loaded Host List, and Most Likely Under loaded Host List.

Output: VM Allocations to avoid SLA violation and reduce Energy consumption. For each Host in data centre {

Finding overloaded host {

If host is overloaded then

Select VM from VMmigrationList1 until host is overloaded

Placement of VM from over loaded host

(VM placement algorithm for Overloaded Host);

}

Finding under loaded host {

If host is under loaded then

Select all VMs from this host

Add all VMs to VMmigrationList2

Placement of VM from under loaded host

(VM placement algorithm for Under loaded Host);

}

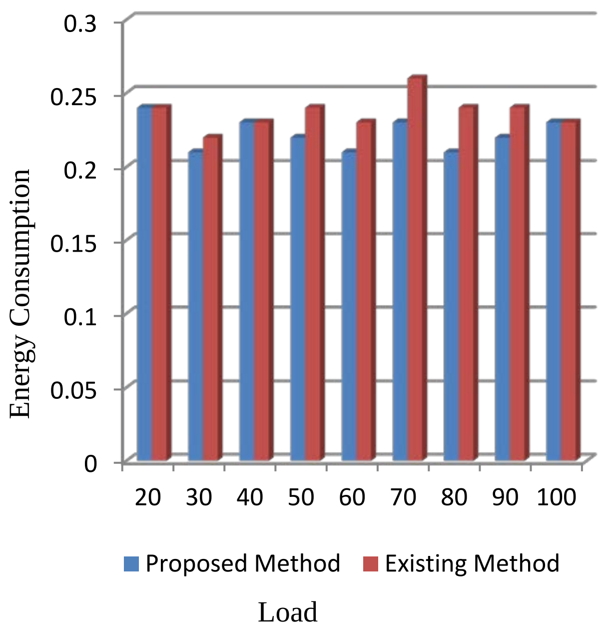
Break

}

The proposed algorithm finds overloaded hosts in first step then selects the virtual machine for migration from overloaded hosts and place this VM using VM placement algorithm for Overloaded Host. After load balancing, find an under loaded host and select all the virtual machines from that host. Place these VMs over least loaded host by using VM placement algorithm for Under loaded Host. To evaluate the performance of the proposed scheme, the CloudSim toolkit was used for simulation and forming of cloud computig environments and evaluation of resource prvisioning algorithm [37]. CloudSim is a new simulation framework for modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services. It provides built in java classes to simulate datacenter, host machine and various strategies. User can evaluate the new strategies (policies, scheduling algorithms, mapping and load balancing etc.) using these all above together. The classes of the libraries can be extended or replaced, new policies can be added and new scenarios for utilization can be coded [38].

VI. EXPERIMENTAL RESULTS

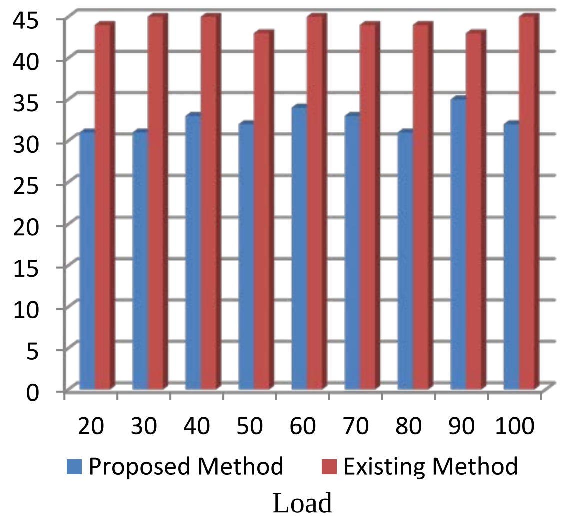
We have analyzed different scenarios by taking 10 hosts, 20 virtual machines and various numbers of tasks (cloudlets) i.e. load to evaluate the performance of proposed algorithm. It is essential to use workload traces from real system. In this simulation we have taken different work load. We have plotted different graphs based on different work load between two strategies, proposed method and the existing method (Static threshold based VM provisioning). The performance of the proposed approach is evaluated for various parameters (i.e. Energy Consumption, Number of VM migrations, Number of SLA violation and Average SLA violation). These results can vary according to the different environment setups.



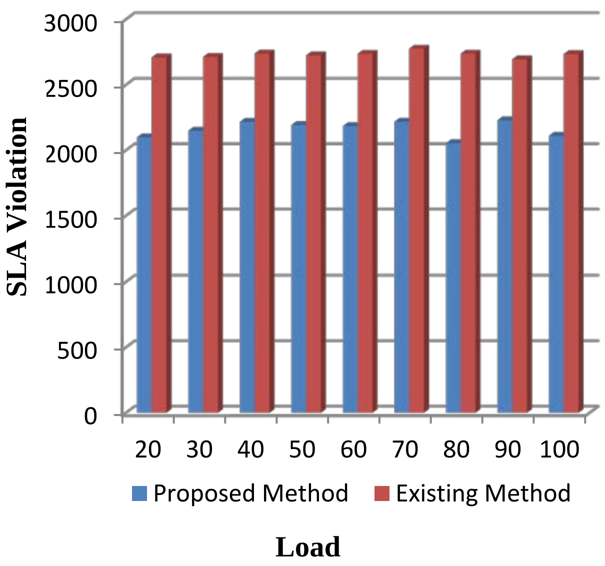
Graph 1: Energy Consumption Comparisons

Energy consmption is compared for proposed method and existing method as shown in figure 4 From graph we have analyzed that proposed method; consumes less energy than existing method.

Number of VM migrations is compared for proposed method and existing method in figure 5. From graph we have analyzed that proposed method; incurs less number of VM migrations than existing method.



Graph 2: Number of VM Migration comparisons

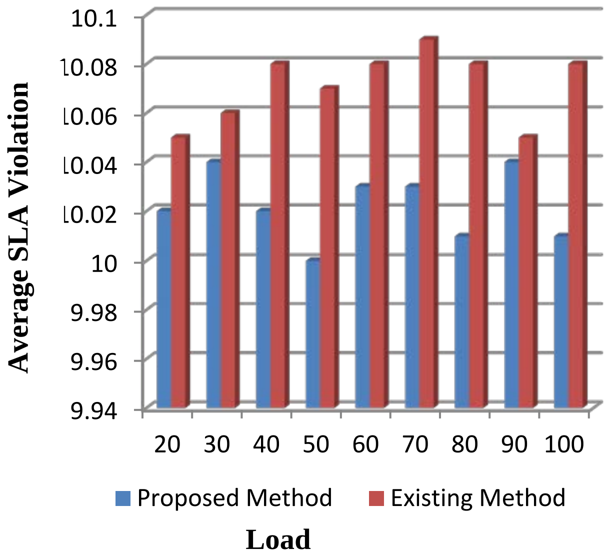


Graph 3: SLA Violation Comparisons

Number of SLA violation is compared for proposed method and existing method figure 6. From graph we have analyzed that proposed method; incurs less number of SLA violations than the existing method.

Average SLA violation is compared for proposed method and existing method in figure 7. From graph we have analyzed that proposed method; incurs less Average SLA violations than the existing method.

The result shows that proposed method Energy Efficient Dynamic VM Consolidation algorithm performs much better than existing method in all scenarios. For metric number of VM migrations, it gives less number of VM migrations as compared to existing method in all situations. Percentage of improvement in result



Graph 4: Average SLA Violation Comparisons

For metric Number of VM migrations is

$$\mathit{Percentange\ of\ improvement} = \left(\frac{(AvgMig_{old} - AvgMig_{new}) \times 100}{AvgMig_{old}}\right)\%$$

where $AvgMig_{old}$ denotes average number of VM migrations for existing method, AvgMignew denotes average number of VM migration for proposed method. In case of number of VM migration the proposed method gives 30 percentage improvement over existing one. For every metric such as SLA violations, Energy consumption and Average SLA violation, the proposed method showed improvement compared to old method.

VII. CONCLUSION

In this research work, an Energy Efficient Dynamic VM Consolidation algorithm which not only minimizes number of VM migrations but also reduces both energy consumption and SLA violations is suggested. Given approach for VM placement incurs minimum overhead time for allocation in cloud computing including efficient resource utilization and load balancing of datacenter. In the VM scheduling model, the virtual machine migration is addressed which aims to provide the server consolidation for underutilized host and manage or balance the load for over loaded hosts.

The result shows better performance for every metric and efficient resource utilization of data centres. It is a critical task to make tradeoff between energy consumption and SLA violation. As far as number of VM migration and

SLA violation is concerned we have achieved a lot of improvement. Proposed method consolidates VM to the minimum number of servers for reducing energy consumption. But still in case of energy consumption more work is needed for further improvement.

VII. FUTURE SCOPES

The future scope will be another strategy to reduce energy consumption while keeping low level of SLA violations and less number of VM migrations.

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