ISSN (Online): 2349-7084
GLOBAL IMPACT FACTOR 0.238
DIIF 0.876

INTERNATIONAL JOURNAL OF COMPUTER ENGINEERING IN RESEARCH TRENDS
VOLUME 2, ISSUE 7, JULY 2015, PP 451-457

Review on Various VM Migration Techniques

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Abstract: Cloud computing is a distributed Environment where storage and cloud resources are available on pay per use basis.The resources can be accessed at any time from remote locations,this will enhance the domain and provide flexibility to store their data or run application online.Recently most of internet users use the service of cloud and so load on cloud servers is growing in direct proportion and would result in ceasing the cloud server if not appropriately managed. To resolve this problem an efficient load balancing technique is needed. Aim of the Load balancing migration technique is to distribute the load among different cloud servers.Load balancing is usually based on Virtual Machine (VM) migrationtechniques. This paper gives the detail survey on various Virtual Machine Migration policies.

Keywords: Cloud computing, Virtual Machine, Virtual Machine Migration, Live VM Migration, Load balancing.

1. INTRODUCTION

Cloud computing is an emerging technology which provides the Infrastructure, Platform, and Software as a services. Cloud computing uses the concept of virtualization and utility computing. Virtualization enables different application to be run concurrently on same physical machine [1]. Cloud Data Center consists of multiple servers and each server hosted multiple VMs. Each VM is capable of executing a specific job and each job are of type On-demand, Reserved, Transactional, and
Batch job [10]. VMs are isolated from each other and controlled under the supervision of hypervisor. Therefore Execution of one job does not affect another job running on different VM (Virtual machine) could be migrated from one physical machine to another physical machine

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According to the load state of aServer which provides scalable dynamic VM provisioning.Virtual machine migration scheduling contains various methods such as Round-Robin Scheduling [2], Weighted Round Robin Scheduling [3], Destination Hashing and Source Hashing Scheduling [4].But all these are static VM migration Strategies, which do not consider the dynamic behavior of application.

1.1 Various VM migration Techniques

Virtual Machine Migration is a technique that migrate a VM with its associated application from one physical machine to another machine.VM Migration can be done in two ways such as live migration and Non Live Migration. Live VM Migration is a technique which migrate VM without disrupting the application running on it, while non-live migration halt the process during migration [1].
Different virtual machine migration techniques are as follows:
i) Energy Efficient Migration Techniques

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Huge amount of data need heavy resource requirement. If this data is not properly managed then it would affect the utilization of server and their cooling. This consumes a lot of power about 70% of maximum power consumption even at their low utilization level. Therefore we need a migration technique that saves the energy of server by optimum resource utilization.

ii) Load Balancing Migration Techniques

Load balancing is a migration technique that distributes the load among different physical server to help in minimizing resource consumption, enhance scalability and avoiding over-provisioning of resources.

iii) Fault Tolerant Migration Techniques

This technique migrates the VM from one physical machine to another even if any part of system fails.

2. DIFFERENT VM MIGRATION POLICIES

2.1A Virtual Machine Dynamic Migration Scheduling Model Based on MBFD Algorithm [5]

In Cloud environment due to rapid changing demand of user load balancing becomes a challenging issue. If the load balancing would not be maintained appropriately then this would lead to wastage of resources and this results in overloaded and under loaded host in datacenters.So we need a mechanism which efficiently achieving dynamic resource allocation in cloud datacenter. These papers propose a modified best fit decreasing algorithm (MBFD) for virtual machine dynamic migration model.

Selection Algorithm is used to select the Hot-Spot Hosts in cloud datacenter.

Selection algorithm criteria is given in equation (1)

$$\begin{cases} U_{cpu}(p_i) > Max_{cpu} \ or \ U_{cpu}(p_i) < Min_{cpu} \\ U_{ram}(p_i) > Max_{ram} \ or \ U_{ram}(p_i) < Min_{ram} \\ U_{band}(p_i) > Max_{band} \ or \ U_{band}(p_i) < Min_{band} \end{cases} \quad \dots (1)$$

In this if the load state of CPU, RAM and Bandwidth is either greater than predefined upper threshold or lower than predefined lower threshold, then migration takes place.

After finding Hot-Spot Hosts, **Scheduling algorithm based on MBFD** is used for virtual machine dynamic migration. In this algorithm firstly hot spot host is arranged in the descending order of their load state, hot spot queue can be shown as in equation(2).

$$\begin{cases} Heat_p = \{p_{1,}p_{1,} \dots \dots p_n\}, \quad n \in N^* \\ U_{p_i} \geq Max \ or \ U_{p_i} \leq Min, \quad \forall_i \in [1, n] \end{cases} \quad \dots (2)$$

Next the virtual machine in the hot spot queue is sorted in the descending order of their load state, which is specified in equation (3).

$$\begin{cases} L_p = \{v_{1,}v_{1,} \dots \dots v_m\}, p \in \ Heat_p, m \in N^* \\ U_i \leq U_j, \qquad \forall_{i,j} \in [1, m] \end{cases} \quad \dots (3)$$

Then we traverse the non-hot-spot host and arrange in ascending order of their resource load state.

$Target_p$indicate the sorted target host queue, which is shown in Equation (4).

$$\begin{cases} Target_p \quad = \{p_1, p_2 \dots . . p_k\} \ \ , k\epsilon \ N^* \\ Up_i \geq Up_j \quad , \forall i, j \ \in [1, k] \\ Min < \ Up_i < Max \end{cases} \quad \dots (4)$$

The most important step is to select the most suitable target host during migration. And the most suitable target is one which has minimum difference between Max threshold and current load of this host

$$.\begin{cases} VTarget_p = p_i \\ Min\{ Max - (U_{pi} + u_j)\} \dots . \\ u_j \in L_p, p_i \in Target_p \end{cases} \quad (5)$$

This virtual machine dynamic scheduling model based on MBFD performs much better than Single threshold VM dynamic scheduling model.

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2.2 Cloud Server Optimization with Load Balancing Using Dynamic Compare and Balance Algorithm [6]

Cloud consists of various scalable resources such as software, hardware and data storage media etc., which can be dynamically allocated according to the user demand. Thiswould result in huge consumption of resources and energy requirement. So we need an optimization technique that would examine both loads balancing as well as energy consumption of cloud data center. This paper proposes a threshold based Dynamic Compare and balance algorithm for cloud server optimization. This not only considers the Load balancing of cloud datacenter but also uses Server Consolidation for minimizing no. of active host server.This paper optimizes the cloud system using dynamic threshold value based on dynamic behavior of users.

Here two threshold values such as Upper_threshold value and Lower_Threshold value is used to manage the load among cloud data center. This threshold value is calculated using total capacity of the server and by their weight coefficient.

$$Upper_{Threshold} = Host\_Limit * \sigma$$
$$Lower\_Threshold = Host\_Limit * \delta \text{....(6)}$$

Where σand $=weight coefficient set by cloud provider on the basis of dynamic behavior of application. And Host_limit define total limits of host in terms of load.

Using current Load we divide the algorithm in to two sections:

(i) If the current load of host is greater than Upper_threshold value .Then host is considered as overloaded, so they apply a load balancing algorithm to transfer the extra load of this host in to another host having H_load is less than Host limit.

(ii)If the current load of host is below than Lower threshold value, then it is considered as under loaded. Then they apply the server consolidation algorithm to transfer the load of this host to another host and switched off this to save energy and cost.

The proposed dynamic threshold based DCABA save cost and increase utilization of servers. Simulation result showthat threshold based algorithm provide better result for cloud server optimization.

2.3 Adaptive Live Migration to improve load balancing in Virtual Machine Environment [7]

Now a day's load balancing had become an important aspect of cloud computing. There is lot of solution regarding load balancing in cloud environment such as static load balancing. But this doesn't consider the dynamic behavior of application. So we need a dynamic load balancing strategy which will migrate the process at run time rather than limiting process where they are first assigned. This paper proposes an efficient load balancing mechanism that makes a decision based on previous mapping. It also incorporates a workload-adaptive live migration algorithm for minimizing VM downtime and improves user experience.

This paper introduces an efficient load balancing framework which reduce a decision generating latency and apply a workload-adaptive approach for minimal downtime.

Load balancing algorithm is centralized means it makes one machine as control node which runs the cloud management software and controls other node where several VM is running. Following are the steps involved in load balancing strategy:

(i)First it calculates the load corresponding to CPU and memory. In context of CPU ,it check how much cycle it takes to execute each VM and compute utilization percentage .For memory it check no. of page fault required for each page loading.

(ii)After examine the load value, it calculate the total and average utilization of the entire machine involved in load balancing.

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$$C_{avg} = \frac{1}{n}\sum_{i=1}^{n} C_i$$
$$C_{diff\ i} = C_i - C_{avg}$$
$$C_{diff\ min} = \min_{i\in\{1,....n\}} C_{diff\ i}$$
$$C_{diff\ max} = \max_{i\in\{1,....n\}} C_{diff\ i} \quad .... \quad (7)$$
$$C_m = \frac{(C_{diff\ max} + C_{diff\ min})}{2}$$

VM live migration will trigger if Cm is greater than threshold T.

(iii) If migration happened then control node examine history record for similar CPU utilization. If record exist then schedule VM migration by selecting same source and destination. Otherwise choose the source close to $C_{diff\ max}$ and destination close to $C_{diff\ min}$ and add this mapping as a new entry in history record.

In this live migration is scheduled by exploiting pre-copy techniques and compress the dirty pages before transmitting it.

2.4 Dynamic VM Consolidation for Reducing SLA Violation in Cloud Computing [8]

Now a day's huge amount of data is rapidly growing on cloud data center lots of cloud user are downloading and uploading text, audio, video, images and variety of data etc. Due to this rapid growth of data, processing of data becomes more tuff task and also data center needs lots of energy mainly because of underutilization of resources. So the objective of cloud computing are to reduce energy consumption while keeping low level of SLA violation. The proposed model design energy aware resource allocation policy to get lower energy consumption with low SLA violation. Mean and Standard deviation of CPU utilization are used for detecting host overloaded or not and positive maximum correlation coefficient to select VMs from overloading hosts. In this approach predicted utilization is used for detecting whether host is overloaded or not.

Predicted utilization Pu have been calculated as equation (8)

$$P_u = E + s * StdDev \quad .... (8)$$

Where s is safe parameter and it is dynamic parameter which *is* the summation of u_{ij} (denote jth vm on ith host) divided by total utilization of H_i.This is defined in equation (9).

$$s = \sum_{j=1}^{M_i} u_{ij} \quad ....(9)$$

E is the mean of the utilization of host H_i, which can be easily figure out by equation (10).

$$E = \frac{1}{p}\sum_{k=1}^{p} X_k \quad .... (10)$$

If predicted utilization is greater than current VM utilization of host, this means that host is overloaded, otherwise host is not overloaded.

After finding the overloaded host, selection algorithm is used to select some VMs from these hosts for migration by using various policies which are as follows:

a)The Minimum Utilization Policy, b) The Random Choice Policy, c) The Minimum Migration Time Policy, d) The Maximum Correlation Policy.

This VM allocation and selection policies for VM consolidation performs much better than previous existing policies but performs little worse for reducing energy consumption.

2.5 Self-Adaptive Task Distribution for Load Balancing using HABACO in Cloud [9]

Cloud computing is an internet based model that provide its user a convenient and huge scalable resources such as servers, cpu, disk drive, application ,network ,services etc. which can be easily accessed with minimal cloud provider interaction. In spite of this load balancing emerges as important issues when unbalancing of cloud server occurs.To defend this problem,this paper proposes a hybridoptimization algorithm HABACO, which is the combination of modified Ant Colony and Artificial Bee optimization algorithm. Thisalgorithm not only balances the load on server but also reduces VM live migration. HABACO is self-adaptive task distribution Technique which automatically search, optimize and balance the load.

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In Ant Colony algorithm, ant has the ability to find an optimal path from his nest to food. In his movement ant lay down some pheromone on the ground, which would use by others to detect it and follow it with high probability.
This characteristic of ant could be applied in the scheduling of load balancing in Cloud Computing.
In previous work, movement of ant is expressed in forward and backward direction. In forward direction it finds the overloaded node by comparing the current utilization of host with its threshold value. In backward direction it find the under loaded host and replace the overloaded virtual machine with other node. This is shown in Figure 1.
In his work it divides the algorithm in three modules:
(a) In first module it finds the entire overloaded node and sent the id of overloaded node to next module. In his movement it updates the pheromone table which contains the threshold value and CPU utilization of each node.
(b) In this module VM is selected based on minimum migration time. And it is repeatedly check until host is not overloaded.
(c) In this module ant find the host with minimum utilization compared to others and send the respected VM to target node which is not overloaded [12].
In his proposed work it uses modified **Ant optimization** which solves many combinatorial optimization problems. In this algorithm ant pass over the whole network in a way that knows about the location of under loaded and overloaded node and while traversing they update the pheromone table which contain information about the utilization of every node.This is divided in to three steps:

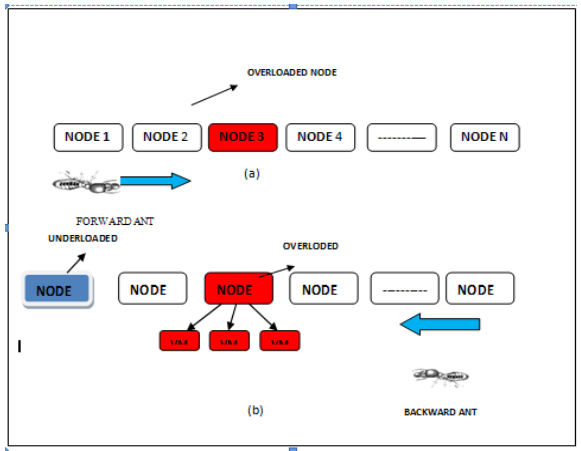

Figure 1.System Architecture of ACO [12]

i) Randomly selecting the head node.
ii)It start from overloaded node by checking the threshold value from global resource table and will search for under loaded node. If meanwhile ant meets an overloaded node then traverse an under load node from the previously defined overloaded node.
iii) Backward movement finds an under load from this overloaded node either moving to previous path or by exploring a new path.

Artificial Beeis self-organized optimization based algorithm. It traverses the whole network and carries information related to resource consumption by VM and share with other node by using probability calculation. In this employed foragers traverse the network and extract information about resource consumption. Onlookers will wait and explore new node based on the information collect from Employed foragers while scout will search for under loaded and overloaded node. Habaco try tofind the optimum solution by running both algorithm and then balance the load in imbalanced cluster.

Table 1.Comparison of Different VM Migration Policies

Technique	Method	Parameter	Outcomes
A Virtual Machine Dynamic Migration Scheduling Model Based on MBFD Algorithm	Modified Best Fit Decreasing algorithm	Load state of Hot spot and Non-Hot spot host	Provide better Load balancing and decrease overhead of virtual machine migration.
Cloud Server Optimization with Load Balancing Using Dynamic Compare and Balance Algorithm	Threshold based Dynamic Compare and balance algorithm	Dynamic Upper and Lower threshold value	Provide improved cost to vendors and better load balancing.
Adaptive Live Migration to improve load balancing in Virtual Machine Environment	Dynamic load balancing strategy and workload-adaptive live migration algorithm	Average of the Maximum and Minimum difference from average utilization of host	Reduces downtime and provide fast and efficient load balancing.
Dynamic VM Consolidation for Reducing SLA Violation	Allocation and selection algorithm	Predicted utilization of host	Reduces Energy consumption and SLA violation
Self-Adaptive Task Distribution for Load Balancing using HABACO in Cloud	Ant optimization heuristic algorithm and Artificial bee Optimization algorithm.	Threshold value	Reduces downtime and Dynamic migration of virtual machine.

3. CONCLUSION:

Virtual machine migration techniques are of two types such as static resource scheduling and dynamic resource scheduling. Static resource scheduling won't consider the dynamic behavior of application. Therefore it is not well suited in an environment where user demand changes dynamically. Whereas dynamic resource scheduling consider the current workload and provide efficient VM migration scheduling. This paper summarizes various VM migration reduction techniques that provide low degree of VM migration with increased utilization of server and save cost of the server.

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