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A STUDY ON LOAD BALANCING AND ENERGY EFFICIENCY ALGORITHM FOR MANAGING THE RESOURCES ACROSS HOST MACHINE IN CLOUD

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Abstract- Cloud computing offers resources and services related to Business as well as I.T related fields as a utility to users throughout the world. Virtualization is the technique used to facilitate data centers by creating virtual machines from physical machines. The energy consumption of computer and communication system does not balance with the workload. A system uses a sufficient amount of energy when it is idle or lightly loaded. The energy efficiency is essential for reducing the usage of energy in product and services. In this paper, we do the study on energy-aware load balancing algorithm in order to understand how this algorithm reduces the amount of power- on PM and average power consumption with power saving.
Keywords – Cloud Computing, Load Balancing, Energy Efficiency, Virtualization

1. INTRODUCTION

Cloud computing is emerging as one of the leading paradigms for providing services models like software as the service model(SaaS), Platform as the Service model(PaaS) and Infrastructure as Service modes(IaaS). It is basically providing services like storage, networking, servers, database etc. Virtualization Technique is used run the application across physical machines.

Load balancing and energy efficiency are one of the central issues in cloud computing [1][2]. It is a mechanism that distributes the dynamic local workload evenly across all the nodes in the whole cloud to avoid a situation where some nodes are heavily loaded while others are idle or doing little work. It helps to achieve a high user satisfaction and resource utilization ratio, hence improving the overall performance and resource utilization of the system.

Live migration [3] allows a virtual machine to shift from one server to another without disturbing the application running within. For instance, whenever there is the high usage of resources in a server, some Virtual machines running on it is migrated in order to decrease the load of the server. If the utilization of resources becomes less, VMs can be balanced so that the idle systems are shut down which results in the decrease in the huge amount of energy consumption.

Lowering [4] the energy usage of data centers is a challenging and complex issue because computing applications and data are growing so quickly that increasingly large servers and disks are needed to process them fast enough within the required time period. This is essential for ensuring that the future growth of Cloud computing is sustainable.

To address this problem and energy efficient cloud computing, data center resources needs to be managed in an energy-efficient manner. In particular, Cloud resources need to be allocated not only to satisfy Quality of Service (QoS) requirements specified by users via Service Level Agreements (SLAs) but also to reduce energy usage.

The rest of the paper is organized as follows. Load Balancing and Energy Efficiency algorithms are explained in section II. Conclusion and future work remarks are given in section III.

2. ENERGY EFFICIENCY, LOAD BALANCING ALGORITHM

2.1 Minimum Cut-Binary Tree algorithm for VM Placement:

Hierarchical clustering is achieved by using the minimum cuts in the undirected graph which we are passing as an input for the algorithm [5] where each vertex is a collection of VM’s and Path is referred as traffic between VM's. Traffic between the VM’s is assigned the Non-negative capacity. And the capacity of cut is determined by sum of all edges. Minimum Cut problem is mainly used to find the smallest capacity in a given undirected graph. And this undirected graph is expressed in terms of the binary tree where it contains Left and Right Sub-trees; Right sub-tree traffic is greater than left Subtree, Leaf nodes represent only one VM.

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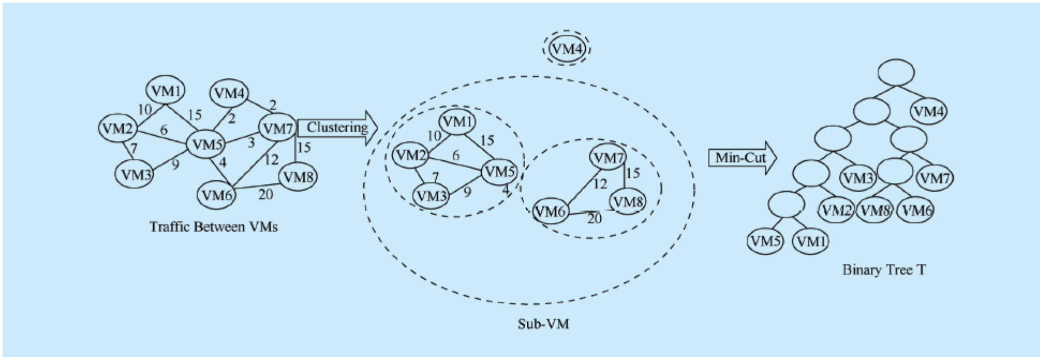

Fig 1. Hierarchical clustering algorithm based on minimum cut

The cut with the minimum number of edges among all cuts in an undirected graph, determining the edge connectivity of the graph.

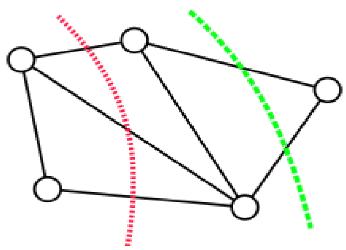

Fig 2. Graph with a Minimum Cut

In an above graph [6] dotted line in red represents a cut with three crossing edges. The dashed line in a green represents one of the minimum cuts of this graph, crossing only two edges. Minimum cut majorly used to find a cut in G with the smallest capacity.

2.2 BF-HC algorithm (Best Fit with hierarchical clustering algorithm):

From the MC-HC algorithm, a binary tree is generated and VM's are placed in the Nodes. And BF-HC algorithm designed based on a minimum cut to combine with Best Fit for solving multi-objective optimization.

The related VMs will be clustered together by the minimum cut to minimize the total network traffic; with the clustering results, BF-HC attempt to reduce the energy consumption of Physical Machine with Best Fit. From BF-HC algorithm VMList is obtained by Pre-order traversal. BF-HC algorithm places all VMs node using VMList. The algorithm helps to find the Larger distance between the pair of VM Nodes and smaller traffic between them.

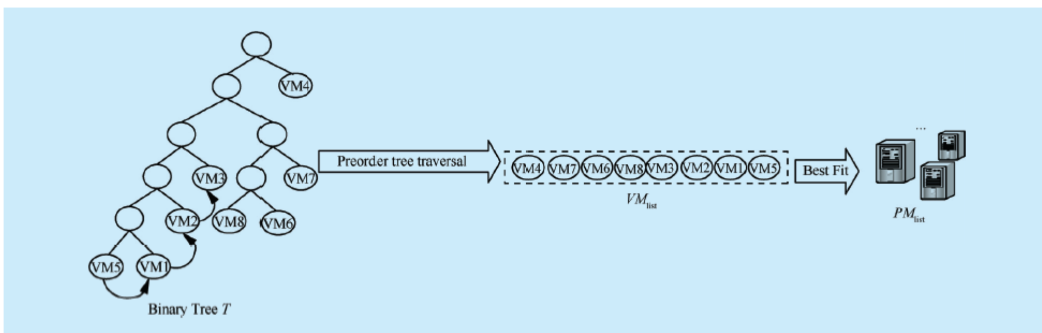

Fig 3: VM Placement algorithm based on BF

For a new VM, BF-HC algorithm search from the first PM until finding the one which best matches this new arrival. Only when all activated PMs cannot accommodate this VM, a new PM can be allocated. Time complex of Best Fit is O(n2), and space complexity is O(n).

2.3 VM migration algorithm:

Migration is done mainly to facilitate the proactive maintenance. If the failure is about to happen, then the potential problem can be resolved before failure of service happens. It's also used for maintaining the load in the machine.

Pre-copy in which first Memory is transferred and after this execution is transferred. Post – copy in this, first execution is transferred and after this, memory is transferred. Unlike pre-copy, in post copy, the Virtual CPU and devices on the destination node transfer in the first step and start the execution in the second step.

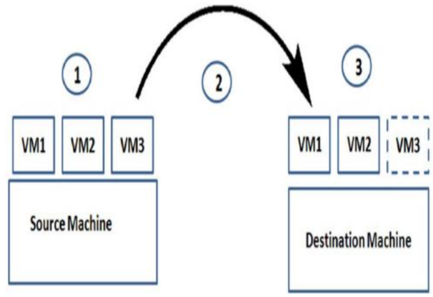

Fig 4. Live Migration of VM

In the VM-Mig algorithm, it begins the operation by checking the workload of the machine along with the Data source. After processing, the algorithm checks whether Migration is needed or not, if required then chooses the Host machine along with VM and Destination Machine. Then algorithm establishes the connection and starts migrating.

If it is successful, then VM starts its execution on the destination machine. If the migration process fails, then again, the algorithm tries to establish a connection and tries to migrate once again. Once Migration completed, Migrated VM is Deleted from the Host/Source Machine. The process is ended here.

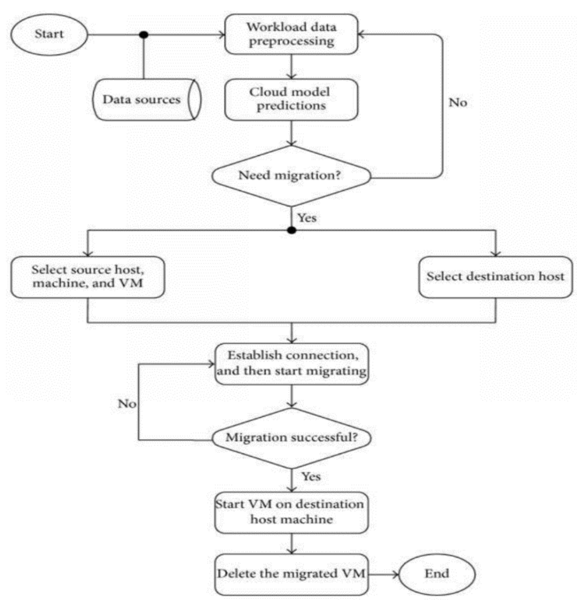

Fig 5. Flow Chart of VM Migration

2.4 Variable Item Size Bin Packing(VISBP):

In Bin Packing Method Physical machines [7] are represented by bin and Virtual machines are represented by items with dynamic Item load called item size. Here items having the same size are usually placed in a minimum number of bins of uniform capacity. There are several Bin packing algorithms to avoid overloading, achieve load balancing and green computing. Such algorithms are cost effective too. There are offline Bin Packing algorithms where the size of the items is known in advance and in online Bin packing algorithm size is not known at the beginning.

The overall aim of the VISBP is to handle the load balancing that emerges as one of the major issues in Cloud computing.

Song et al studied the Variable Item Size Bin Packing Algorithm, an online bin packing algorithm which uses live migration to achieve load balancing by allocating resources dynamically. The main idea behind VISBP is to establish stability throughout the system.

The input of VISBP algorithm is usually carried out through 3 operations, like insert, update, and remove. Whenever such operations are performed items are broken based on the size which has to be equal and also the gap between the bins of each Item. Items could be categorized into tiny, small, medium and large depending on their sizes. Sometimes breaking of items can also be done based on the contents, be it filled or unfilled depending on the gaps between the bins. The main reason for categorizing the items is to minimize the wastage of resources and the spaces. Since VISBP is an online bin packing algorithm it follows Next Fit, First Fit and Best Fit methods to place the items into the bin. In Next Fit, an item is placed in the active bin if it has space else it opens a new active bin for insertion. In First Fit, items are placed in the first available bin and in the case of Best Fit, items are placed in the first bin but according to their size.
The overall aim of the VISBP is to handle the load balancing that emerges as one of the major issues in Cloud computing.

2.5 Harmonic Mix:

It is a dynamic online Bin Packing algorithm which is similar to VISBP but here we can assume the size of the Items to be larger than the fixed value. For eg, In VISBP if the fixed size is defined as 1/6, the Items with atmost sizes are grouped together to form multi items within the range of the fixed value. But in Harmonic Mix [8] we can define the size to be more than 1/6 say,1/8 and all the items with atmost sizes are grouped within that range. To improve the competitive ratio of the algorithm we need to use valid packing.
Valid Packing divides the items based on their size as tiny, small, medium and large. Based on the availability of the spaces in the bins items with smaller sizes can be placed in the bigger bins. For eg, a medium bin can have not only the medium-sized items but also the smaller sized or the tiny sized items as well, depending on the spaces available but it cannot have a large sized item. Harmonic algorithm places tiny, small, medium and large items in separate bins at first and then the gaps are filled if necessary using a certain type of Valid Packing called as nice packing. Harmonic mix updates and maintains a nice packing after an insert or a delete operation. For inserting an item of a certain size to the bin, at first availability of the spaces are checked in the bins having higher capacity. In case of availability, the items with smaller size are placed in the bigger bins else a new active bin is created to place that item in it.
The movement of items from one bin to another depends upon its size. Also, another replacement is made to maintain the stability of the bin. These usually include many moves within and outside of the respective bins.
It takes no moves to insert the tiny items into the bin whereas 2 moves to remove tiny items from the bin. It takes 2 moves to insert small items into the bin and 5 moves to remove small items from the bin. Insertion of the medium item requires 2 moves and deletion takes 5 moves. Inserting large items takes 5 moves and removal requires 3 moves from the bin. Updating the size of an Item requires atmost 7 moves.
For eg, if we want to insert a small-sized new item to the bin, first we need to check the large bins for small or medium spots. If it is available place the new item and remove atmost 2 tiny items from the large bin and then reinsert it to maintain the Nice Packings. If there is no place the new item is placed in the active bin.
The advantage of Harmonic Mix is that the items of the same type can replace each other to maintain the packings. Harmonic Mix also aims at handling load balancing within the bins i.e. Physical machines, effectively.

3. CONCLUSION

Cloud computing is a new Paradigm in which different resources are accessed by multiple users on-demand basis through internet. The point of our exploration is to diminish the temperature of the active servers and to distribute the workload in an efficient way considering Energy efficiency and power balance of the system. we studied on energy efficiency load balancing algorithm in order to understand how these algorithm can reduce the number of power-on physical machine and average power consumption with power saving.
In future we practically compare the algorithms to check the efficiency in power in different environment setup.

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