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Multi-Knapsack Based Approach For Energy Efficient VM Migration In Cloud Computing

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Abstract - Cloud computing is widely used as an means to outsource work of industries. Due to its wide use many algorithms are proposed to make it even more efficient. In cloud number of physical resources is shared among the users via a concept known as virtualization. As lots of energy is consumed in this technology so algorithms to save energy and improve efficiency are proposed termed as Green algorithms. In this paper a green algorithm for VM Migration is proposed using multiple 0-1 knapsack algorithm. Results show that proposed algorithm performs better as compared to other approaches in terms of VM Migrations, energy consumptions and VM consolidation.

Keywords: Knapsack problem, multi knapsack. Virtual Machine (VM).

I. INTRODUCTION

Cloud computing is defined as the ability to use computing resources – applications, storage and processing over the internet. The above mentioned resources are hosted and managed by the cloud service provider. It is an approach to maximize the capacity or step up capabilities without investing in new infrastructure. It provides gigantic storage for data storage and high performance computing to customers over the web [3].

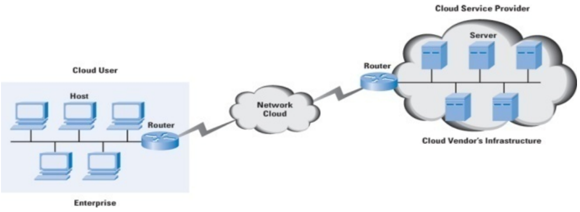

Fig 1.1: Figure showing cloud

Cloud primarily refers to saving of user's data to an offsite storage system that is maintained by a third party. This means instead of storing information on user computer's hard disk or other storage devices, client save it to a remote database where internet provides the connection between user computer and the remote database [3].Clouds enable platform for dynamic and flexible application provisioning by exposing data center's capabilities as a network of virtual services. So users can access and deploy applications from anywhere in the Internet driven by demand and QoS requirements.

Cloud Computing Services: Cloud computing service models or offerings can be classified into 3 segments :

•IaaS – Infrastructure as a Service: Includes servers, storage, virtual machines, load balancers and other core infrastructure stack. It is used by large sized organization [4].Here we need to configure Server through Network Administrator . For develop and Deploy software we need skilled IT developer team.Leading IaaS Service Provider are Amazon, Rackspace, IBM and HP.

•PaaS (Infrastructure + Platform)- Platform as a Service. Adds development and programming models to IaaS. Includes databases, execution frameworks/runtimes, web servers and development tools. Here we need only Programmers team to develop and deploy software [4]. Leading Paas Service Provider are Google app Engine, Windows azure, force.com.

•SaaS(Infrastructure + Platform +Software)- Software as a Service. Complete application offering in the cloud [4]. Salesforce CRM, Google Apps/Gmail/google drive/gtalk/GoogleCalendar, Microsoft "Live", Dropbox, and a lot more. Here we only select a software that is offered by service providers, and we customize a software as our requirement. Need only Administrator or Cloud Consultant for initial setup.

II. LITERATURE REVIEW

In [12] an admission control and scheduling mechanism proposes which not only maximizes the resource utilization and profit, but also ensures that the QoS requirements is proposed. Mixed Workload Aware Policy (MWAP) is implemented to consider the workload of different types of application such transactional and non-interactive batch jobs. The proposed mechanism provides substantial improvement over static server consolidation and reduces SLA violations. • In [13] VM consolidation problem which is a NP Hard problem is solved by applying meta-heuristic algorithm ACO. The objective is to lower down the energy consumption of the overall algorithm. And the algorithm also reduces VM migrations. In [6] a novel allocation and selection policy for the dynamic virtual machine (VM) consolidation in virtualized data centers to reduce energy consumption and SLA violation. Firstly, it detect overloading hosts in virtual environments and then apply a method to select VMs from those overloading hosts for migration. VM Provisioning Method to Improve the Profit and SLA Violation of Cloud Service Providers. In [2] authors proposed an Threshold based algorithm for VM provisioning among multiple service providers that reduces SLA Violation.

It uses two threshold values and two type of VMs (on-demand and reserved),These threshold values will be decided by the cloud federation depending on the environmental conditions like current workload, idle capacity of each cloud provider, etc. In [11] a power friendly algorithm is proposed. This paper compared live and non live VM migration in terms of power consumption.

In [16] authors developed an objective method to facilitate the comparison of different virtual machine placement algorithms in the cloud. In [17]stable matching framework to decouple policies from mechanisms when mapping virtual machines to physical servers are presented and a general resource management architecture called Anchor is proposed. In [18] the resource allocation problem to be a convex optimization problem and proposed a self-organizing cloud architecture is discussed. Speitkamp and Bichler [20] studied the static consolidation problem with a mathematical programming approach.In [19] they modelled the consolidation as a modified bin-packing problem. These works focus on the initial VM deployment or static consolidation problem based on resource utilization and do not consider VM migration overhead.

Multi-Knapsack problem

In multi-knapsack problem, given multiple knapsacks and objects with fixed capacity and profit. The objective is to earn maximum profit while utilizing maximum capacity of each knapsack.

This problem is similar to the VM allocation problem where there are multiple physical machines (PMs) and virtual machines (VMs). The objective is to allocate VMs to these PMs utilizing maximum capacity of PM close to upper threshold.

```
Multi-Knapsack VMM
{
    1. Initialize cloud datacenter;
    2. Initialize cloud entities;
    3. Select the PM with highest capacity;
    4. Utill(selected PM capacity reach near upper
       threshold)
    5. {
    6.   Allocate VM;
    7. }
}
```

Upper threshold = 85%

Lower threshold = 25%

III. EXPERIMENTAL SETUP

In this paper cloudSim is used to simulate cloud environment. CloudSim is a java based library for simulating cloud.

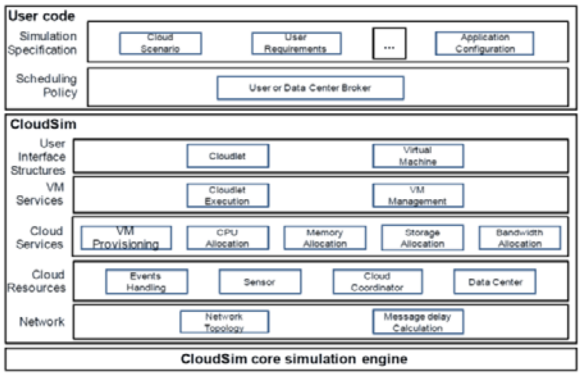

Fig 1.4: Figure showing CloudSim architecture

CloudSim steps for Simulation:

- Set the no. of user.
- Initialization of common variable.
- CIS will be created by using init method.
- Datacenter will be created by using createDatacenter method. In this for each datacenter ,we create a host with its characteristics.
- Datacenter broker instance will be created .
- Create Instance of virtual machine with PE ,RAM and Bandwidth requirement.

Now this virtual machine is submitted to broker.

Infrastructure has been developed at this point.

- Cloudlet is created with Bandwidth and MIPS requirement.
- Now this Cloudlet will get submitted to Broker.
- Start Simulation process.
- Stop Simulation process.
- Print the status of the Simulation.

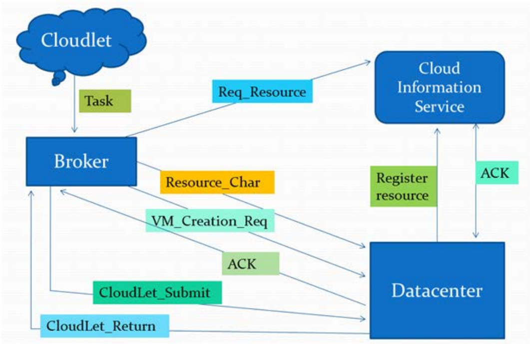

Fig 1.5: Figure showing cloud architecture.

IV. RESULTS

In this paper a cloud is simulated using cloudsim having fixed number of physical machines and virtual machines. Configuration of physical and virtual machi.nes is measured in terms of MIPS (million instructions per second). VM Migrations, VM consolidation and energy consumption are recorded.

Physical machines are created based on the following MIPS list as shown below:

{750, 1000, 1500, 2000}

Virtual machines are created based on the following MIPS list as shown below:

{250, 500, 750, 1000}

No. of VM Migrations are compared for traditional VM Migration approach (TVMM), and Multi-Knapsack based approach (MKVMM).

Table 1.1: Table showing no. of VM migrations for different approaches

Number of VM migrations			
No. of PMs	No. of VMs	TVMM	MKVMM
10	15	7	1
15	20	9	2
20	25	11	6
25	30	16	10
30	35	19	11

Table 1.2: Table showing no. of VM consolidations for different approaches

Number of VM consolidations			
No. of PMs	No. of VMs	TVMM	MKVMM
10	15	2	7
15	20	3	6
20	25	5	10
25	30	8	14
30	35	11	18

Table 1.3: Table showing energy consumption for different approaches

Energy consumption in KWH			
No. of PMs	No. of VMs	TVMM	MKVMM
10	15	3	1
15	20	5	2
20	25	7	6
25	30	8	7
30	35	12	10

V. CONCLUSION AND FUTURE WORK

In this paper multi-knapsack approach is proposed for VM migration in cloud. As described in this paper VM Migration is a NP-Hard problem and this problem can be solved in less time using some algorithm like multi-knapsack problem. All such implementations can be effectively simulated using a tool called CloudSim. In this paper multi-knapsack algorithm is applied and performance of traditional approach is compared in terms of No. of VM Migrations, Energy consumption and VM consolidation. It is concluded that proposed approach gives better results

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