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Resource Allocation Algorithm for Datacenters in Cloud Computing

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Abstract— Clouds are rapidly becoming an important platform for scientific applications. Virtualization facilitates the provision of flexible resources and bill there user based on processor time or number of VM instances. Cloud applications consume huge amount of energy, this also cause high operational cost. This paper presents a Cost-efficient and energy effective scheduling in cloud environment which consider both monetary cost and energy Cost efficient scheduling consider monetary cost and energy consumption of VM while allocating the task to each VM. Energy effective scheduling schedule the VM to host by considering the CPU utilizations of each VM. The suggested scheme is validated by conducting a performance evaluation study using the Cloudsim Toolkit. The results demonstrate that the suggested scheme can offer significant reduction in monetary cost and energy while executing the tasks.

Keywords— Cloud Computing, Task scheduling, Energy efficiency, Datacenters.

I. INTRODUCTION

Cloud computing is known as a provider of dynamic resources using virtualized resources. In cloud computing resources are dynamically allocated to each user programs according to their needs. Users have to pay for the resource which their programs actually consume.

Task scheduling is one of the challenging issues in cloud environment. A task scheduler schedules the tasks to the resources according to the adaptable time. Scheduling involves finding out a proper sequence to execute the tasks. Task should be reallocated when some processors become overloaded. Efficient task scheduling should meet user's requirements, improve the resource utilization, and reduce monetary cost and energy. An effective task scheduler can enhance the overall performance of a cloud environment. High energy consumption of data centres has become a great problem in the development of cloud computing. The energy efficiency of servers in a data centre can be increased by applying task scheduling strategies.

Characteristics of a good optimizer are to be considered for this

- Should meet SLA
  SLA (Service level Agreement).It is a contract agreed between customer and cloud provider. Scheduling should meet the Qos mentioned in SLA.
- Distributed resources.
  Task scheduling is based on some constraints like cost, make span, energy and power consumption. Cloud computing uses distributed resources. Hence determination of actual cost, cpu utilization...etc are very difficult.
- Computational Complexity

In cloud environment users have to pay for the resources that are used. Total cost can be reduced by optimizing the resources. Cloud providers can offer two plans for computing resources, one is reservation and on-demand plans. In general, cost of utilizing computing resources by reservation plan is cheaper than that by on-demand plan.

There are six levers which can be used for resource optimization:

- Optimize by consolidating under-utilized resources.
- Optimize based on time of day usage.
- Optimize based on seasonal demand variations.
- Optimize based on life cycle usage variations.
- Optimize by standardizing platforms.
- Optimize by application rationalization

The energy costs of data centres are rapidly increasing. In addition to energy costs, cooling costs for data centres continue to increase because the ever-increasing power consumption by servers leads to increased heat dissipation. As energy costs are increasing every year, more focus should be given to the energy efficiency factor than performance, while optimizing the data centre resource. Green Cloud Computing is intended to achieve efficient processing and utilization of computing infrastructure, and minimize energy consumption [1].Energy consumption per task is influenced by the CPU utilization of servers. It also affected by the resource utilizations such as memory, bandwidth…etc.

II. RELATED WORK

Commonly used scheduling algorithms are FCFS, Round Robin, Priority scheduling…etc. In FCFS, Job in the queue which comes first is served. This algorithm is simple and fast. In the round robin scheduling, processes are dispatched in a FIFO manner but are given a limited amount of CPU time called a time-slice or a quantum. If a process does not complete before its CPU-time expires, the CPU is preempted and given to the next process waiting in a queue. The preempted process is then placed at the back of the ready list. The basic idea is straightforward: each process is assigned a priority, and priority is allowed to run. Equal-Priority processes are scheduled in FCFS order. The shortest-Job-First (SJF) algorithm is a special case of general priority scheduling algorithm. An SJF algorithm is simply a priority algorithm where the priority is the inverse of the (predicted) next CPU burst. That is, the longer the CPU burst, the lower the priority and vice versa. Priority can be defined either internally or externally. Internally defined priorities use some measurable quantities or qualities to compute priority of a process.

But most of these algorithms are mainly concentrated on the minimization of makespan. But in cloud environment cost and energy are very important factors. Some scheduling algorithms are there which considers total monetary cost, and energy while scheduling.

Techniques like Dynamic Voltage Frequency Scaling, VM consolidation, Server power switching and resource throttling have been made to make cloud computing more power aware and energy efficient.

1) Dynamic Voltage Frequency Scaling Technique [7].

Every electronic circuitry is associated with an operating clock. The supply voltage can be regulated by adjusting the operating frequency of the clock. But this method is heavily depends on hardware and not controllable according to the varying needs.

2) Resource Allocation or VM Migration Technique

VM migration is a technique used to make cloud environment more energy efficient. Each physical machine host in the cloud environment contains a number of virtual machines upon which the applications can be transferred according to varying needs and available resources

Virtual Machine (VM) technologies have the ability to migrate running OS instances across different physical nodes. Migration includes movement of VM from one physical server to another. This capability can be utilized in today's enterprise environments in order to provide efficient online system maintenance, reconfiguration, load balancing, scheduling …etc.

Lists of other techniques are also used to make cloud more energy efficient like work load consolidation, server consolidation…etc.Workload consolidation is increasingly used to host multiple applications on a single server, sharing and multiplexing a server's capacity over time. Server consolidation is an approach to the efficient usage of computer resources in order to reduce the total number of servers or server locations that an organization requires. Server consolidation refers to the use of a physical server to accommodate one or more server applications or user instances.

III. COST-EFFICIENT SCHEDULING ALGORITHM

Execution of a program can be viewed as the executing multiple tasks contained in that program. These tasks can be represented by a DAG [2]. Independent tasks in a DAG can be executed by multiple VMs simultaneously. Some systems have been developed for scheduling the tasks in a DAG.Dryad [3] is a parallel and distributed application developed by Microsoft for DAG based task processing. Different task scheduling algorithms are there for scheduling the tasks [4] [5] [6].

Let G = (V, E) be a DAG, where V is the set of v tasks to be executed and E is the set of edges representing the precedence constraints between tasks. Assume that G has an entry task, V_{entry} .and an exit task V_{exit}.The longest path of a DAG is the critical path (CP). The weight of a node v_i, denoted by dt_{vi} represents the computation load for task v_i.Cloud computing environment consists of a set of m fully connected heterogeneous VMs, denoted by M. Let ca_{mj} denote the CPU cycles allocated to VM m_j. Each task can be executed on a different VM.

Cost efficient scheduling uses an objective function for each node $V_i \varepsilon V$ which considers execution time, cost and energy.

$$\text{Minimize}: \alpha \times T(i,j)+\beta\times C(I,j)+\gamma\times P(i,j) \quad \text{for all } m_j \ \varepsilon\ M \qquad (8)$$

$$\text{Subject to} \quad T(i,j)=\frac{t(vi,mj)-tmin}{tmax-tmin} \qquad (9)$$

$$C(i,j)=\frac{c(vi,mj)-cmin}{cmax-cmin} \qquad (10)$$

$$P(i,j)=\frac{p(vi,mj)-pmin}{pmax-pmin} \quad \alpha+\beta+\gamma=1 \qquad (11)$$

t_{min} (t_{max}),c_{min}(c_{max}),p_{min}(p_{max}) are the minimum (maximum) execution time, monetary cost, power consumption, each task in a scheduling plan.

Algorithm1:Scheduling Algorithm for Cost

Input: Set of tasks.
1. Compute priority of each task.
2. Sort them in the descending order of its priority.
3. **for** each task **do**
4. **for** each VM **do**
5. Calculate value of objective function(8).
6. end
7. end
8. Assign the task to the VM that minimizes the objective function.
10.**end**

IV. ENERGY EFFECTIVE SCHEDULING ALGORITHM.

As energy costs are increasing every year, more focus should be given to the energy efficiency factor than performance, while optimizing the data centre resource. Energy consumption per task is influenced by the CPU utilization of servers. It also affected by the resource utilizations such as memory, bandwidth…etc.This algorithm sort all VMs in decreasing order of their current CPU utilizations, allocate each VM to a host that provides the least increase of power.

Algorithm2: Scheduling Algorithm for Energy.

Input: List of host and VMs.
1Calculate CPU utilization of each VM.
2. **for** each VM **do**
3. **for** each Host **do**
4. Calculate power (VM, Host).
5. Allocate each VM to a host that provides the least increase of power.
6. return

V. EXPERIMENTAL EVALUATION

Performance of Cost efficient and energy effective scheduling (CES) is compared with the existing Hybrid scheduling through cloudsim simulations. The cloud in the simulation is generated with 12 VMs in a fully connected manner. The base price for the slowest VM is 0.5 dollars per computing unit.

Three comparison matrices are used to analyze this scheduling; makespan, cost, energy. Makespan is the total execution time required to execute the task. Cost is the total monetary cost and Energy is the total power consumption of VMs.

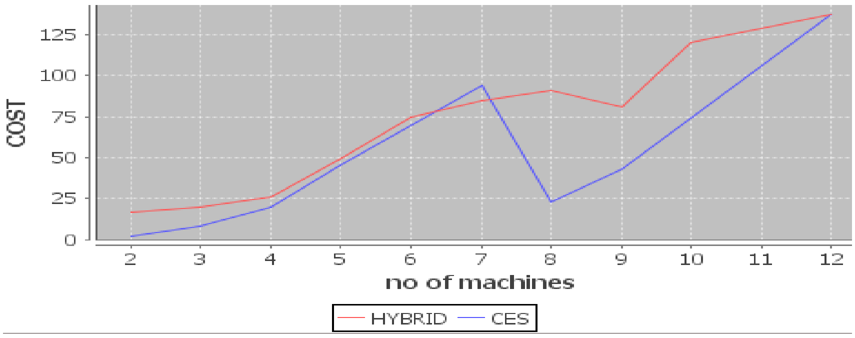

Fig: 1.Total monetary cost

The total monetary cost for the CES and Hybrid is compared in Fig. 1.Gisraph contains no of VMs on x axis and cost on y axis It is clear that the proposed scheduling achieves lower cost than the Hybrid scheduling in almost all the cases.

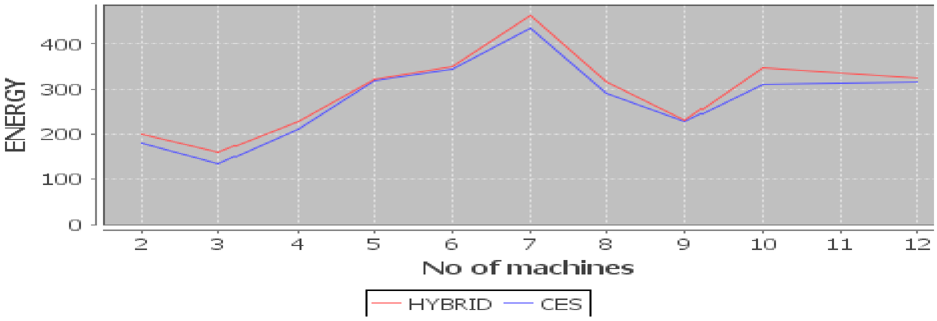

Fig: 2.Total Energy

This scheduling scheme considers power consumption of each VM. Fig 2 represents comparison of energy consumption between two scheduling plans. In this graph x axis represents no of machines and y axis represents energy. It is clear that the proposed scheduling achieves lower energy than the Hybrid scheduling in almost all the cases.

VI. CONCLUSION

Most conventional scheduling algorithms were concentrated only on makespan. But this paper proposes a cost efficient and energy effective scheduling which consider cost while scheduling the task to VM and power while scheduling the VMs to hosts. This scheduling can reduce the cost and energy while producing make span as good as possible.

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