A Novel Hybrid GAACO Algorithm for Cloud Computing using Energy Aware Load Balance Scheduling

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Abstract—**The process of spreading workloads and computing resources through one or more servers is cloud load balancing. This method of delivery ensures maximum response time at low throughput. The workload is divided between two or more servers, storage devices, network connectivity or other data centers, thus allowing efficient use of resources and response time for the device. To ensure device cloud performance, an energy-aware operating model is implemented which is used for load balancing. The method describes an energy-optimal operating regime and seeks to optimize the number of servers that run under this regime. To save resources, idle and lightly charged servers are moved to one of the sleeping states. A Genetic Algorithm and Ant Colony Optimization (GAACO) framework for energy-efficient cloud computing is specified based on meta-heuristics inspired by nature, namely novel QoS based on hybrid genetic ant colony, and load scheduling algorithm. The proposed energy-aware QoS load balance scheduling was implemented in an ns3 simulator and the performance was evaluated in terms of packet loss ratio and throughput.**

Keywords—Ant Colony Optimization (ACO), Energy Consumption, Genetic Algorithm, Load Balancing, QoS, Throughput

I. INTRODUCTION

The next wave of computing consists of cloud computing which is growing rapidly and the consumers' demands for more services. Every day, the IT industries expand and the need for computing and storage resources grows with cloud computing. Large quantities of data and information are developed and shared over the protected or unsecured network, which further requires the need for highly powerful computing resources. Organizations are expanding their organizational base to emerging virtualization technology, such as cloud computing, to enable the most of their investment. Cloud computing gives the consumer ample tools upon their request [1][5]. Software or hardware resources may be the necessary resources. The cloud computing systems are decentralized as well as parallel and at the same time satisfy the needs of many clients. Cloud architecture requires several processors. Clients in a distributed environment produce a query at random in any network processor. The biggest downside of it is related to job assignment. The processor's uneven allocation of the task produces disparity i.e., some processors are severely overloaded and several of them are underloaded [3][8]. The function is moving the load from overloaded operation to an undercarriage. Load balancing in a distributed system is very important for successful operations. We need to move the tasks between the different nodes in the cloud network to obtain better performance, fast response time and high resource usage [2][27].

The practice of spreading or splitting workloads and various computing resources through one or more servers accessible is known as cloud load balancing. Such a distribution ensures maximum throughput with the shortest response time. The burden is distributed over two or more servers, storage devices, network interfaces, or other computing resources, allowing for more efficient resource use and faster device response times. As a result, effective usage of cloud load balancing will result in improved business operations for a website with a high volume of visitors [4][6][9].

To maintain the advent of cloud computing opens the way for consumers to realize the dream of providing digital services as a utility. The software, development environments and infrastructure resources are supplied to

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users via large and small cloud services. The data centers, though, fail repeatedly from their ever-increasing energy consumption and CO2 emissions. In addition, the money a datacenter spends on energy usage main key role in determining the service cost of the cloud provider[5] [7]. As per the study of the Natural Resources Protection Council (NRDC), the energy demand of U.S. datacenters is projected to exceed 140 billion kilowatt-hours of electricity in the current 2020 year, which is equal to 50 large coal-based power plants producing nearly 150 million tons of CO2 [10][12].

Incidentally, a datacenter 's key source of energy consumption is its business servers, which absorb more than 60 % of the total energy consumption. Make span, response time, latency, packet loss and throughput are the primary considerations for every website hosted on the World Wide Web adds even more loss and delay to the packets than the response time. This delay comes from the website's latency, which is largely attributed to internet delays in propagation of transmission. There are several factors to this latency beginning with the DNS lookup, the bandwidth of the connection etc [9][11].

Throughput on the other hand reflects the maximum simultaneous requests or transactions per second which can be managed by the web application. When operating applications on the cloud, latency and throughput are important factors to consider when determining the type of computing resources required. Assume the web application has been configured and performance tweaked, and you want to load test it on the cloud utilizing several CPU instances for maximum efficiency [13][15]. The cloud scheduling focus is on improving the task process. An excellent algorithm for scheduling tasks leads to greater performance of the system. The problem of scheduling tasks is regarded as a concern of the NP. There were several suggested algorithms to tackle the NP problem. Genetic Algorithms and Ant Colony Algorithms, along with some other heuristic algorithms, are accompanied by fast refinement and robustness [14][17].

The principle of load balancing tends to be a gain without any downside. The algorithms will reduce energy consumption, with no decreases in efficiency at the same time. However, tests in the real world demonstrate that it has a downside, and it affects the system. This topic is complementary to existing research into literature and does not restrict the search for different algorithms. Nevertheless, the study must also consider downsides in order to move an idea out of the test lab into a working data centre [16][18][20].The main contribution of this work is to describe the hybrid load balance scheduling algorithm to access cloud resources with increased throughput . The problem statement mentioned above clearly distinguishes this work from other recent work. It provides as much detail as previous works. The following is how the paper is structured: Section II goes over the related work. Section III describes the system methodology, and Section IV presents the results, which are followed by a conclusion.

II. RELATED WORK

Effective task scheduling mechanisms will fulfill the standards of users and increase resource efficiency, thereby improving the cloud computing environment's actual quality. This scheduling technique not only meets user needs, but it also saves a lot of energy., which has been proven in the Cloud Sim toolkit with simulation performance [19][29]. Taking into account One of the most difficult scheduling difficulties in cloud datacenters is the allocation and migration of reconfigurable virtual machines, as well as the integrated hosting characteristics of physical equipment. For Cloud datacenters, we deploy a dynamic and optimal resource scheduling approach (DAIRS). An integrated method is used to calculate the total imbalance level of a Cloud datacenter as well as the average imbalance level of the application.. Results show that DAIRS has improved results in terms of total level of imbalance, average level of imbalance for each server, as well as overall runtime [21][22]. Non-preemptive activity scheduling in a cloud computing environment is an unrecoverable restriction that must be assigned to the most suitable virtual machines at the moment of first placement. To make cloud computing more effective and efficient, the related heterogeneous resources are managed via static or dynamic scheduling, which assigns tasks to appropriate resources. The suggested technique for scheduling and load balancing considers each virtual machine's (VM) functionality, the length of each work requested, and the dependency of numerous activities [26]. A multidimensional resource scheduling model based on Fuzzy is established to achieve resource efficiency scheduling on cloud platforms in an integrated resource scheduling [23].

Cloud infrastructure efficiency is highly dependent upon task scheduling and load balancing. Researchers around the world are therefore proposing various load balancing algorithms and techniques whose purpose is to spread the workload equally across all the virtual machines while achieving the objective. Recent years and increased understanding of climate change have shown how critical modern society's energy efficiency is. Computing is becoming more common in humanity, and is thus a major factor in growing energy consumption.

With the growth of cloud computing as a concept, the construction of huge data centres has become increasingly important. takes on a higher and higher percentage of the electricity generated. Recent studies have shown that approximately 2% of overall energy demand comes from data centers. These host the infrastructure for modern cloud computing. Load balancing isn't a new problem. During the time of distributed computing in the 1950s a somewhat similar area was researched. Just as in the past , different ideas exist for managing the load in a cloud environment. This research question is aimed at understanding the fundamental idea behind the algorithm. This work aims to provide the hybrid algorithm to improve the performance of load balance scheduling.

III. SYSTEM MODEL

Cloud Performance of the cloud environment is a multi-objective process in which optimum use of the most critical resources is needed. data center is an aggregation of several physical machines, each physical machine is divided into several virtual machines related to resource requirements such as memory, Processing time, energy consumption, network band width.

3.1 Energy Model

In this area, the major focus is on energy usage. The energy model's goal is to keep the environment safe, capability of efficient energy utilization. Energy modeling is more relevant because it raises the need to use less resources while attaining optimum resource usage.

The power dependent model of the system is shown below.

$$P = aCv^2 f \quad (1)$$

Where

□ is voltage,

□ is clock frequency,

□ is capacitance load and

□ is an activity factor which shows the number of switches per clock cycle.

The above equation clearly shows that the predominant element is supply voltage, which can affect its reduction for power reduction. Since voltage is directly correlated with frequency v hbf and ~f, the power relationship may be P = aCv3.

$$E = P*T \quad (2)$$

where

T is the time it takes to reply to tasks on average.

The method of allocating jobs top processors is the challenge in this study regarding task scheduling. DVS is supported by each CPU. [25][28]. `

$$\square = \square\square\square^{3} \sum_{\square=1}^{\square} \underline{\square}\,(\square_{\square}) + \sum_{\square=1}^{\square} \underline{\square}\,(\square_{\square}) \quad (3)$$

3.2 QOS Model

The model is composed of three node layers. The top layer node represents a cloud service's QoS values, or an integrated cloud services package. The middle layer comprises the service's QoS parameters QA (i,n) i=1, ... ,n. The bottom layer contains modes C (j m) j = 1 , ...,. -- mode of cloud service has an effect on the QoS parameters and thus on the QoS value. On the other hand, the QoS value also affects the effectiveness of any mode of operation. Here we presume that each mode of service is independent from one another [24][27].

The load of its □th dimensional resource is

$$\square_{\square\square} = \frac{\sum_{\square=1}^{\square} (\square^{\square}_{\square\square}(\square_{ij}+\square_{\square\square\square\square}))}{\square^{\square}_{\square}} \quad (4)$$

□□ is mean value of all its □-dimensional resources' loads,

$$\square_{\square} = \frac{\sum_{\square=1}^{\square} \square_{\square\square}}{\square} \quad (5)$$

3.3 Genetic Algorithm

i) Selection

The selection probability for each person is determined according to the fitness function value.

ii) Crossover

This work intends for adaptive methods of convergence. Larger probability of crossover interactions a little amount amongst individuals, in order to avoid an early incidence. As crossover probability reduces in the latter part of the algorithm, it's able to increase new good individuals and increase the convergence rate.

3.4 GAACO Algorithm

Step 1: Initialize qos weight factor w_i ..where $\sum_{i=1}^{n} \quad w_i = 1$, $q = n$, number of cycles C.

Step 2: Define qos service model function, load function and fitness function.

Step 3: Select randomly the first application.

Step 4: Selection, crossover and mutation.

Step 5: Calculate the providers loads.

Step 6: Rank feasible providers into increasing order based on expected load.

Step 7: The provider which having low expected load is selected for h.

Step 8: Add h to $\tilde{S}j\ (t)$ and the ant list.

Step 9: Calculate objective function $(\tilde{S}j\ (t))$, for generated solution of ant j.

Step 10: best solution = $(\tilde{S}j\ (t))$.

IV SIMULATION RESULTS

Our proposed algorithm's efficiency for load balancing is evaluated using NS3.It is a robust simulation platform for cloud system modeling, testing, and simulation [19]. The simulation uses between 10 and 50 virtual machines, depending on the number of tasks. To assess the results, we use 100 to 400 task numbers. Figure 1 illustrates packet loss ratio.

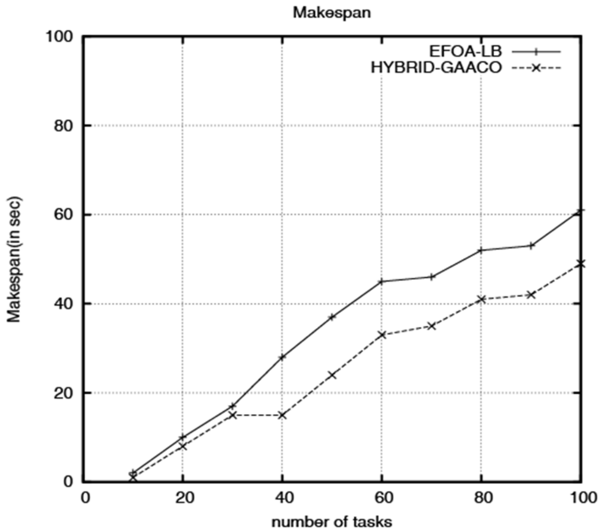

Figure 1. Packet loss comparison with Hybrid GAACO and EFOA-LB

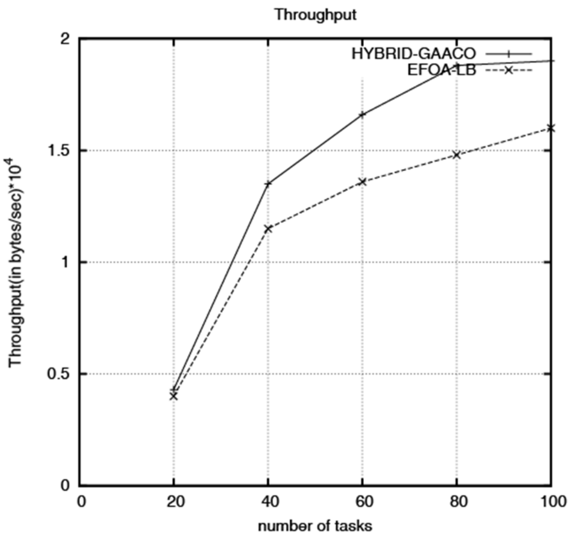

Figure 2. Throughput comparison with Hybrid GAACO and EFOA-LB

We showed that the GAACO hybrid algorithm improved the load balance for the network. We configured our experimental configurations with current traffic scenarios and measured network efficiency on the traffic forecasted. Evaluation of the QoS parameter on the traffic forecasted is helpful in detecting high-risk ties that need attention

V. CONCLUSION

A framework for energy-efficient cloud computing is based on a hybrid genetic ant colony, and a load scheduling algorithm is proposed. Genetic algorithm is invoked for efficient generation of the initial pheromone for ant colony optimization. QoS goals are measured with the built fitness feature. The proposed energy-aware QoS load balance scheduling was implemented in a ns3 simulator and the performance was evaluated in terms of packet loss ratio and throughput.

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