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A Review on Optimal Techniques for VM Scheduling in the Cloud Environment

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Abstract

Cloud computing is a Pay-Per-Use model which provides services and various resources to the users in an efficient way using the internet without involving much economic investment. Due to this low cost involvement and also simple implementations CC has found its applications in so many areas. It is uniquely enriched with various features like heterogeneous, flexible, distributed, location independent, on demand self service and universal network access. Gaining popularity due to its indifferent quality of being operable even on underlying physical infrastructure i.e. it does not require any special infrastructure to use the services and resources from the cloud. Cloud Computing works on virtualisation. The user does not have any information and details about the physical infrastructure of the service provider such as location, platform where the function is running etc. Therefore for load balancing of such systems proper arrangement of the operations is required. And for this purpose Scheduling came into existence. Scheduling in CC is performed at two levels- 1. Host Level (VM Scheduling- Allocation of PEs to the Hosts) 2. User level (Cloudlet Scheduling-Allocation of cloudlets to VM for execution). However in this paper we are proposing a new algorithm for allocation of PEs to VMs. We have proposed a better output of the algorithm by using an optimisation technique - Ant Colony Optimisation.

Keywords *- Cloud Computing (CC), Cloudlet, Virtual Machine (VM), Processing Element (PE), ANT Colony Optimisation, Virtualization.*

1. INTRODUCTION- Cloud Computing is a parallel and distributed system which consists of numerous software, virtualised computers which are interconnected, storage etc which can be directly in access to the user for which the user needs to pay for only the facilities they opt for. Thus by this feature, the CC model is becoming popular in IT as it lets the user have hands on special databases at a very minimal cost. Scheduling is the allocation of suitable task to the hosts for execution. In cloud environment this task is very important to effective utilization of the resources. Virtual machine is the software employment of computing environment to install or run a program. Allocating resources to the virtual machine and moving applications between virtual machines are important parameters. In the cloud infrastructure virtual machines are scheduled for multiple data centres which may be geographically distributed. In cloud computing environment scheduling policies, resource and infrastructure utilization are defined under scheduling optimization process. Virtual machines are scheduled on the cloud to maximize their utilization. Scheduling helps to increase the quality of service and to achieve maximum benefit for cloud service provider. Companies can reduce the cost by energy saving and obtaining the cloud computing services. Optimization process leads to consume less energy, faster execution of job, and efficient resource allocation. In IaaS (Infrastructure as a Service) model of cloud computing virtualization is an effective solution to manage dynamic resources. Scheduling algorithms aims at the mapping of virtual machine to the physical server. It also focuses on resolving the problem of heterogeneity to achieve the load balance dynamically. Virtual layers facilitate optimum resource utilization by allocating virtual machines according to the user needs of the resources. Virtual machines allow multiplexing of hardware resources which enables different users to share the physical machine with the isolation from each other. Virtual machines may

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be of different characteristics in terms of CPU speed, memory size and other physical resources assigned to them. Though virtual machines provide best solution for balancing the load of the system dynamically but the problem of underutilization of resources may arises. Underutilization is due to inefficient distribution of the resources by scheduling algorithms. Underutilization leads to the problem of overloaded servers which further leads to heat generated by overloaded servers and turns to increased cost of cooling system. Appropriate virtual machine scheduling handles two problems simultaneously the mapping of VMs to physical machines and how to select the virtual machines for load balancing, so, in literature two terms are always referred as configuration of virtual machines and placement of virtual machines to physical machines in the cloud computing environment. The theme of the work is to propose the architecture of dynamic scheduling and load balancing to the energy efficient cloud architectures. In the coming sections A and B, we are elaborating cloud computing types and task scheduling respectively.

Figure 1. Cloud Computing Demonstration

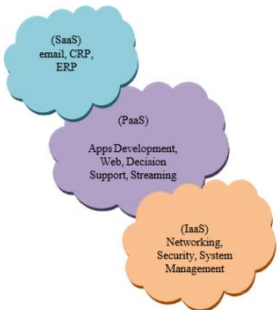

Figure 2. Cloud Computing Services

A. Cloud Computing Types

Based on the location parameter, cloud computing can be divided [into following categories:

Public Cloud: Here, computing infrastructure is provided by the vendor and customer has no visibility on the infrastructure. But the resources can be accessible publically.

Private Cloud: Here, infrastructure is developed for a private organization. The services can be access by that private organization only. This type of cloud is more secure than a public one.

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Hybrid Cloud: A hybrid cloud is come into existence after merging a private as well as the public cloud. Critical applications may be deployed on a private cloud and the applications having less security can be connected to the public one.

Community Cloud: Here, the infrastructure is shared between organizations of the same community.

B. Task Scheduling In the cloud computing for the purpose of services, many resources are used such as processors, memory, storage and many applications. The resources are designed and acquired as per needs. The cloud computing prototype had reduced the acquiring cost of hardware and software and maximized the services. Cloud resources are shared between end-users using the concept of virtualization. Virtualization allows optimum utilization of physical resources and energy under remote running environments. A Virtual Machine (VM) works as a vital component of software stacks in the cloud datacenter. As we described earlier the industries have started to move on cloud and the number of users is increasing day by day, so the task scheduling is a key point in cloud computing. The task scheduling is a milestone in the area of computer science. For the quality of service, resources allocation among tasks sent by users in a certain time can be handled by scheduling. The target of task scheduling is to ensure on which resource and when a task should be assigned and executed. The hot topics of research may be processed scheduling means thread handling in an operating system, energy management through task scheduler in cloud computing. In last few years, cloud computing has attracted people because of reliability, scalability, cost reduction and information sharing parameters at anytime and anywhere. In the present time, cloud computing is the prime target of everyone rather than other technologies for the purpose of research and utility in real life. In cloud computing, the target of a process scheduler is to make ensure the proper assignment of all resources among the jobs sent by the different users. A vast number of users requests for a lot of tasks to the cloud system, so it‟s a challenging issue for cloud system to assign all resources to all tasks. This has to be done keeping in the mind that the Quality of Service (QoS) must not be suffered. In order to ensure Quality of Service to the users, it is a hard necessity of efficient job scheduling. As usual, the users will have the hesitation to pay in the absence of desired performance. So scheduling is the key factor in cloud computing culture. The proper utilization of all available resources at an optimum level is the main aim of the cloud computing system. The scheduling algorithms play a vital role to achieve the same. So, users requested tasks need to be scheduled properly using task scheduling algorithms. The prime goals of a scheduling algorithm are to minimize the execution time, maximize the utilization of resources and load balancing. To assign the task in a proper sequence under problem specific constraints is the main purpose of task scheduling in any computing system. The efficient resource scheduling leads to the high performance of cloud computing environment. The maximum existing scheduling algorithms consider various factors as their prime duty like reducing cost, minimization of make span, optimization of scheduling rate, resource utilization and lots more. In the next section, we are going to present a lot of research papers related to task scheduling algorithms and make their intense elaboration.

a) Fundamental Scheduling Algorithms The fundamental algorithms used in task scheduling are following:

i) FCFS (First Come First Serve) algorithm – Usually, this algorithm is considered for parallel processing. It assigns the jobs to the resource having the shortest waiting queue for incoming jobs i.e. it works on the principle of first in first out. Its drawback is that the last job has to wait for a long time.

ii) Round Robin Scheduling Algorithm – It also handles tasks based on the pattern of first in first out. Here in RR algorithm, time is split into various interval slots. If one job is taking more time to complete itself, then the CPU is given to next job which was waiting in a queue.

iii) Min-Min Algorithm – At very first, this algorithm computes minimum execution time for all tasks and then it assigns shortest jobs to the fastest resources. It is more stable than FCFS algorithm.

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iv) Max-Min Algorithm – This algorithm works same as that of Min-Min except that it assigns the largest job to a fastest resource. Its performance is better than FCFS and Min-Min algorithms.

v) Priority Based Algorithm – This algorithm works on the basis of priority concept. Here, a job which requires high computing power is given a first priority, a job which needs low computing power is given a low priority and a job which requires medium computing power is given a medium priority. After that, the free resource having high power is assigned to higher priority job. This algorithm performs better as compared to FCFS, Max-min and Min-Min.

vi) Most Fit Task Algorithm – In the case of MFT algorithm, the task which fits best in a queue is executed first, but this algorithm has higher failure rate.

2. LITERATURE REVIEW ON EXISTING ALGORITHMS The main target of this paper is to put light on various algorithmic strategies related to task scheduling in cloud computing environment. The techniques are as follows: 1) Symbiotic Organism Search Optimization Based Task Scheduling in Cloud Computing Environment M. Abdullahi designed a discrete version of Symbiotic Organism Search meta-heuristic algorithm. To schedule independent tasks, this method was implemented in CloudSim tool. Among various virtual machines make span, response time and degree of imbalance were measured. DSOS performance was found better than SAPSO. DSOS minimized average makespan 3.8% - 25.5% which is less than SAPSO for 300 through 1000 instances of tasks respectively. In a larger search space DSOS outer-performed than SAPSO.

2) A Novel Scheduling Algorithm for Cloud Computing Environment S. Sagnika introduced a task scheduling hybrid algorithm which is based on Genetic Algorithm using a queuing model in order to reduce waiting time, and length of the queue of the system. The simulation was performed for comparative analysis between FCFS and GA. The experiment elaborated that GA gave 20% better results than FCFS. The simulation parameters were an average number of customers and average waiting time.

3) Multi-Objective Tasks Scheduling Algorithm for Cloud Computing Throughput Optimization In order to improve the throughput, L. V. Atul proposed a multi-objective task scheduling algorithm without disturbing Service Level Agreement (SLA) for SaaS cloud environment. The proposed approach is an optimal scheduling technique. Authors said maximum task scheduling algorithms are based on only execution time but in the case of cloud computing environment various parameters are needed like execution time, cost and bandwidth of user etc. The proposed algorithm was simulated using CloudSim and gave better throughput and outperformed than FCFS and priority scheduling.

4) Multi-Objective Task Scheduling in Cloud Environment using Nested PSO Framework R. K. Jena proposed multi-objective task scheduling nested Particle Swarm Optimization technique in order to optimize processing time and energy. This TSPSO technique was simulated in CloudSim which is an open source (freely available) tool. The simulation results were compared with existing algorithms (BRS and RSA) and found better with respect to optimal balance results in the case of multi-objectives tasks scheduling. The parameters of simulation were used a number of datacenters, a number of PE per Datacenter, Speed of PE, Power Consumption, a number of Tasks, Tasks length, time, energy and failed tasks. The proposed approach fits where datacenters and user job changes dynamically. This multi- objective approach worked effectively using the system resources to reduce energy and makespan. So the proposed technique MOPSO is better than BRS and RSA techniques.

5) Random task scheduling scheme based on reinforcement learning in cloud computing P. Zhiping suggested fine-grained cloud computing system model and optimized task scheduling scheme. In fact, authors designed a novel approach to task scheduling based on reinforcement learning and queuing theory in order to optimal task scheduling. The state aggregation technologies were employed to speed up the learning progress. Authors developed a tool for simulation in MATLAB and used the parameters like the length of job, the total numbers of jobs, the total number of VMs, VM memory,

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VM bandwidth and number of VMs buffer, the number of PEs requirements, a number of datacenters and number of hosts for experiments. The results exhibited the task scheduling efficiency and bare the relationship between the arrival rate, server rate, number of VMs and buffer size.

6) A Hybrid Heuristic Workflow Scheduling Algorithm for Cloud Computing Environments M. Sahar offered a hybrid technique using Particle Swarm Optimization and Gravitation Search algorithms. The proposed algorithm worked on parameters like Processing Cost, Transfer Cost, and Deadline Limitations. This approach can be used by both end-users and utility providers. All the experiments were simulated in CloudSim toolkit. The simulation results showed about 70%, 30%, 30% and 50% cost reduction after comparison to nonheuristic technique, PSO algorithm, gravitational search algorithm and hybrid genetic-gravitational algorithm respectively.

7) Enhanced Particle Swarm Optimization for Task Scheduling in Cloud Computing Environments Awad said the key factor of cloud computing is task scheduling means, to allocate best suitable resources for the task to be executed. While executing a task the parameters should be considered like time, cost, scalability, make span, reliability, availability, throughput etc. The proposed algorithm worked for availability and reliability whereas most scheduling algorithms do not work for reliability and availability in cloud computing environment because of the complexity. The authors proposed a mathematical model using Load Balancing Mutation a particle swarm optimization (LBMPSO) for task scheduling based on the parameters like execution time, reliability, transmission time, round trip time, makespan, transmission cost, and load balancing between virtual machines and tasks. LBMPSO worked for resources management and rescheduled task that lead failure allocation. The proposed model LBMPSO was compared with standard PSO, random algorithm, and Longest Cloudlet to Fastest Processor (LCFP) and found that it gave better results considering the parameters like makespan, round trip time, execution time and transmission cost, and task assignment. This approach can work for any number of resources and tasks.

8) Dynamic Multi-Objective Task Scheduling in Cloud Computing Based on Modified Particle Swarm Optimization I. Awad said task scheduling is a vital research area in cloud computing. The proposed approach is a mathematical model multi-objective Load Balancing Mutation particle swarm optimization (MLBMPSO) used to schedule the allocation of tasks to resources. It was based on two objective functions to reduce total cost and round trip time. The proposed approach improved the reliability in cloud computing and considered the availability of resources and ensured load balancing between a virtual machine and tasks in comparison to other algorithms. This technique could be used to allocate any number of tasks and resources.

9) An Agent-Based Approach for Resource Allocation in the Cloud Computing Environment F. E. Mohamed told that resource allocation is a major issue in cloud computing. In cloud computing, the users and providers have various and different aims; users want to minimize the expenditure of minimum time and efficiency while providers target to reduce the revenue by increasing the resources utilization. On the other hand, it is quite difficult to use the resources in an effective manner and allocate the resource mutually. Researchers proposed an agent-based approach to knot various cloud providers with various cloud users. The main aim of the proposed approach was to allow users to pick up appropriate resources according to their need. The simulation results showed that autonomous agent had provided the intelligence to the cloud for user‟s interactions and resources allocation.

10) An Energy-Saving Task Scheduling Strategy Based on Vacation Queuing Theory in Cloud Computing Chunling said reducing energy consumption in cloud computing is a very important issue. In cloud computing, incoming jobs have nature of randomness and computing node needs power all the time to await incoming tasks which lead to energy wastage. So, scientists proposed an energy saving task scheduling algorithm using queuing model. Here first, vacation queuing model was used with exhaustive service to reproduce task schedule for heterogeneous cloud computing environment. Secondly, scientists analyzed time and energy consumption of computation nodes in above said heterogeneous cloud environment. Later on, a task scheduling algorithm was proposed based on

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similar tasks to reduce the energy consumption. After performing simulation results it was found that the proposed algorithm was able to perform better and can reduce energy consumption effectively.

11) A Novel Cost-Based Model for Energy Consumption in Cloud Computing Horri proposed an energy consumption model for time-shared policy in virtualization layer of cloud computing system. CloudSim simulator was used for modeling of time-shared policy for cost and energy usage based upon the output obtained from the real system, after that the proposed model was evaluated with various scenarios. The cache interference costs were considered in the proposed technique and the costs were based on the size of data. After simulation, it was found that the energy utilization might be extensive and it could be different with different parameters such as the quantum parameter, data size and the number of virtual machines on a host. The output showed that the proposed model was valid and demonstrated that there was a trade-off between QoS and energy utilization in cloud computing system.

12) Virtual Machine Scheduling in Cloud Computing Environment T. Yousef demonstrated a generalized precedence algorithm which gave efficiency in contrast with FCFS and Round Robin Scheduling. The results were computed in CloudSim for the unreliable number of virtual machines workload outlined and justified that it provided a good production as compared to usual scheduling methodologies.

13) Dynamic Task Scheduling Algorithm based on Ant Colony Scheme N. Kamolov said finding the optimal solution is called as NP-hard. Ant colony optimization method could be used for designing of efficient scheduling methods. In this research, scientists proposed a task scheduling algorithm that used a modified ant colony optimization technique. The proposed method was implemented in WorkflowSim for performance measurement. After simulation, it was concluded that the proposed Probabilistic Load Balancing Algorithm (PLAC) reduced average makespan about 6.4% as compared to usual Ant colony Optimization and 11.5% as compared to Min-min method.

14) Optimized service level agreement based workload balancing strategy for cloud environment S. Rajeshwari presented a two-stage scheduling algorithm. The proposed algorithm was implemented using CloudSim tool and used response time as a parameter. After experiments, it was found that the proposed algorithm gave better response time, effective resources consumption, reduced waiting time and load balance among servers as compared to existing algorithms.

15) Task Scheduling Using PSO Algorithm in Cloud Computing Environments M. Ali implemented a Dynamic Adaptive Particle Swarm Optimization algorithm (DAPSO) in order to enhance the performance of basic Particle Swarm Optimization by reducing the make-span and increasing the resource consumption for a task. The proposed method is the combination of Dynamic PSO and Cuckoo Search method which is called MDAPSO. The simulation showed that MDAPSO and DAPSO performed well as compared to original PSO method.

16) Evaluating map reduce tasks scheduling algorithms over cloud computing infrastructure Qutaibah evaluated the major Map Reduce scheduling algorithms like FIFO, Matchmaking, Delay and multithreaded locality on virtualized system. The evaluated algorithms were tested on behalf of two parameters: simulation time and energy consumption. The results showed that the MTL technique is better than existing schedulers.

3. EVALUATION OF ALGORITHMS- We have studied various latest task scheduling algorithms proposed by various scientists. The comparison of latest task scheduling algorithms is shown in Table 1. The comparison parameters are as Make span, Response Time, Degree of Imbalance, Execution Time, VM Buffer, Server rate, Round Trip Time, Transmission Time, Task Distribution, and Energy Consumption etc. The tools used by various researchers are Cloud Sim, Work Flow Sim, and Mat lab.

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4. CONCLUSION AND FUTURE WORK- In this review work, multiple algorithms for load balancing and scheduling for the task in Cloud Computing are analysed with their issues. Review work conclude that the every scheduling algorithms proposed previously includes of various merits and demerits in their way of application This paper elaborates a number of research papers related to task scheduling techniques in cloud computing. In existing algorithms optimization as well as other techniques like PSO, GA, Enhanced PSO, ACO, Queuing Theory, Agent-Based approach, Multi-Objective approach and lots more have been used. The main focus of these algorithms was to minimize makespan, reduce execution time, transmission time, consume less energy even after incrementing in the numbers of jobs and VMs, proper use of VMs buffer size etc. Symbiotic Organism Search Optimization based algorithm performed better in terms of makespan, response time and degree of imbalance for a larger search space. Genetic Algorithm based on Queuing Model outer-performed than FCFS. Multi-Objective task scheduling algorithm performed better than FCFS and Priority Based algorithm in an account of execution time. Multi-Objective task scheduling using Nested PSO gave better results than BRS and RSA techniques. Random Task Scheduling based on Reinforcement worked effectively in load balancing as well as task scheduling. Hybrid Heuristic Workflow Scheduling worked better in cost reduction as compared to PSO, Gravitational Search, and Hybrid Gravitational Search algorithms. Enhanced Particle Swarm Optimization gave maximum efficiency to reduce round trip time, execution time, transmission time and achieved load balancing as well. Dynamic Multi-Objective task scheduling based on Modified PSO improved task completion time, execution cost, and distribution of tasks over different nodes. Agent- Based Approach for Resource Allocation provided the intelligence to the cloud for user‟s interaction and resource allocation. PLAC algorithm using modified PSO was found better than ACO and Max-min in terms of minimum makespan and average makespan. As we discussed earlier in our paper, the different kind of industries have started to move in cloud computing and the users of cloud computing are increasing day by day. To achieve overall system performance with limited cost factor, a better algorithm for task scheduling is expected to schedule different user‟s tasks.

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