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Comparative Analysis of Various Cloud Based Scheduling Algorithms

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Abstract–Cloud Computing is getting lot of attention by research community. It provides virtualized resources dynamically and built on the base of distributed computing, grid computing and virtualization. Algorithms are vital to schedule the jobs for execution, in which tasks can be performed by a computer system, generally incorporated into the operating system. The scheduling algorithm is needed by a cloud computing to arrange resources for executing jobs. Various techniques purposed in the literature have been thoroughly covered in this survey paper and related issues and challenges have been highlighted.

Keywords - Cloud computing, Green Energy-Efficient, Improved differential evolution, Dynamic Resource Allocation, Job Scheduling, The Proposed Just In-Time, Adaptive Energy-Efficient, Hierarchical Reliability-Driven.

I. INTRODUCTION

Cloud computing is very popular in recent years. It is a system distributed over a network in which a program on application runs on many connected computers at the same time. It is taken as a hardware machine of company, combination of Grid Computing and Cluster Computing. Cluster of distributed computers providing on-demand computational resources or services to the remote users over a network [1]. National Institute for Standard Technology (NIST) defines cloud computing is a pay-per-use model for enabling available, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cloud Computing offers subscription based access to Infrastructure, Platforms, and Applications that are popularly referred to as IaaS (Infrastructure as a Service), PaaS (Platform as a Service), and SaaS (Software as a Service) that helps business organizations, academic institutions, government organizations in cutting down operational expenses [2].

Based on resource ownership, Clouds can be categorized as Private, Public or Hybrid Clouds. In Private Clouds, resources are under the legal and contractual umbrella of the organization and thus permanent applications requiring high control over data, security and QoS are most suitable for private Clouds. Public Clouds being owned and managed by third parties. It is less secure than private cloud. However, Hybrid Clouds combine the benefits of both approaches to accommodate high workload spikes [3].

Initially, scheduling algorithms were being implemented in grids. Grid performance is very less; now cloud is used to implement scheduling. Usually tasks are scheduled by user requirements. The scheduling strategies proposed to overcome the problems between user and resources. For large number of simple tasks in cloud system increases the cost and the cost is decreased if we have small number of complex tasks [4].Scheduling is a very important problem in cloud computing environment.

Scheduling becomes difficult only when the number of users in cloud gets increased. Therefore, there is a need to go for a better scheduling algorithm than existing one. This can be done by comparing and evaluating the various existing algorithms, thereby identifying the loop holes in the existing algorithms [5].

Moreover, rest of the paper is organized as: Section II describes the various comparison parameters used. Section III presents various scheduling algorithms. Based on the literature survey, various open issues have been discussed in IV and the paper is finally concluded in Section V.

II. COMPARISON PARAMETERS

Various parameters have been used in this paper to compare various scheduling algorithms:

A. Throughput: It is the amount of work that a computer can do in a given time period. A benchmark is used to measure throughput. In general terms it is the rate of production or the rate at which something can be processed.

B. Response time: It is the total amount of time it takes to respond to a request for service. The response time is the sum of the service time and wait time. Technically response time is the time of system or functional unit takes to react to a given input.

C. Resource utilization: the amount or sources used to perform particular task is known as resource utilization. The objective is to utilize resources efficiently so as to maximize customer service levels, minimize lead times, and optimize inventory levels.

E. Fault tolerance: It is setup configuration that prevents a computer network device from failing in the event of an un-expected problem or error. It enables a system to continue operating properly in the event of the failure of one or more faults within some of its components.

F. Execution time: It is the time during which a program is running and single instruction, such as addition or multiplication, is carried out in the execution of a computer instruction.

G. Scalability: The ability of the system to meet the increasing demands and growing amount of the work is known as scalability.

III. EXISTING SCHEDULING ALGORITHMS

Different scheduling algorithm in cloud computing for planned scheduling are as listed below:

A. Green Energy-Efficient Scheduling Algorithm

In [6] paper author proposed a scheduling algorithm for cloud data centre with a dynamic voltage frequency scaling (DVFS) technique. This algorithm can efficiently increase resource utilization and it can also decrease the energy consumption for executing jobs. The DVFS technique is commonly used in electrical devices such as cell phones, PDAs and PCs to reduce the power consumption.

B. Improved differential evolution algorithm (IDEA)

In [7] author proposed a scheduling algorithm which Optimize task scheduling and resource allocation based on the proposed cost and time methods on cloud computing environment. This cost model includes the processing, receiving model and time model includes receiving, processing and waiting time.

C. Dynamic Resource Allocation Algorithms

In [8] author proposed a resource optimization mechanism with preemptable task execution can increase the utilization of clouds. The author proposed two online dynamic resource allocation algorithms for the infrastructure-as-a-service (IaaS) cloud system with preemptable tasks. This algorithm adjusts the resource allocation dynamically. It is based on the updated information of the current task executions and importantly improves the performance situation where resource contention is fierce.

D. Job Scheduling Algorithm

The job scheduler is needed by a cloud datacentre to arrange resources for executing jobs. In [9] author proposed an algorithm known as job scheduling based on Berger model. The job scheduling algorithm establishes dual fairness constraint. The first constraint is to classify user tasks by QoS preferences and the second constraint is to define resource fairness justice function to judge the fairness of the resources allocation.

E. Just In-Time Scheduling Algorithm

The proposed algorithm [10] is fault tolerant against the premature termination of spot instances and also robust against performance variations of Cloud resources. The just in-time scheduling algorithm maps ready tasks submitted by the task dispatcher onto Cloud resources. The algorithm along with a suitable instance type also selects an apt pricing. The two pricing models spot and on-demand instances to reduce the cost of execution whilst meeting the workflow deadline.

F. Adaptive Energy-Efficient Scheduling Algorithm

In [11] paper Author presented an Adaptive Energy-efficient Scheduling (AES), which combines the Dynamic Voltage Scaling (DVS) technique with the adaptive task duplication strategy .The AES algorithm justifies threshold automatically, thus improving the system flexibility. In the first phase, author proposes an adaptive threshold-based task duplication strategy, which can obtain an optimal threshold. In the second phase, it schedules the groups on DVS-enabled processors to reduce processor energy whenever tasks have slack time due to task dependencies.

G. Hierarchical Reliability-Driven Scheduling Algorithm

Grid scheduling does not adequately consider the reliability requirements of an application. Recognition of this problem author designs a hierarchical reliability-driven scheduling architecture that includes local scheduler and a global scheduler. The local scheduler measure task reliability of an application in a Grid virtual node. In [10] author proposed a hierarchical reliability-driven scheduling algorithm based on quantitative evaluation of independent application reliability. The experiments based on both randomly generated graphs and the graphs of some real applications show that hierarchical scheduling algorithm performs much better in terms of system reliability, schedule length, and speedup.

Table I: Comparison table between Existing Scheduling Algorithms

Scheduling Algorithms	**Throughput**	**Response Time**	**Resource Utilization**	**Fault Tolerance**	**Execution Time**	**Scalability**
Green Energy-Efficient Scheduling Algorithm	NO	NO	YES	NO	YES	NO
Improved differential evolution algorithm (IDEA)	NO	YES	YES	NO	YES	NO
Dynamic Resource Allocation Algorithms	NO	YES	NO	NO	NO	NO
Job Scheduling Algorithm	NO	NO	NO	NO	YES	NO
The Proposed Just In-Time Scheduling Algorithm	YES	NO	NO	YES	YES	NO
Adaptive Energy-Efficient Scheduling Algorithm	NO	NO	NO	NO	NO	NO
Hierarchical Reliability-Driven Scheduling Algorithm	YES	NO	NO	NO	NO	NO

IV. OPEN ISSUES

Based on the extensive survey done in the previous section, a lot of good work has been reported in the literature. However, there is still a need of scheduling techniques that covers all requirements accurately. The main issues of scheduling algorithm in cloud computing are the power consumption, cost and time, resource allocation, response and access time which results in algorithms performance. Another issue is energy efficiency which is very vital factor in scheduling algorithms. Scheduling is one of the key issues in the management of application execution in cloud environment.

V. CONCLUSION

Due to challenges associated with Scheduling such as energy efficiency, resource allocation, preemptable tasks, scheduling algorithms in cloud computing is more challenging as compared to other networks. In this paper, we have surveyed the various existing scheduling algorithms in cloud computing and tabulated their various parameters. From the survey, we also noticed that disk space management is critical in virtual environments. Existing scheduling algorithms does not consider reliability and availability. Therefore there is a need to implement a scheduling algorithm that can improve the availability and reliability in cloud environment.

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