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Resource Scheduling in Cloud: A Comparative Study

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Abstract— Cloud computing provides a platform where services are facilitating to the cloud user through the web, either free of cost or lease base. The cloud user and demands are increasing, due to this large number of service request are submitting to the cloud service provider. To manage those service requests, scheduling plays a key role for the service provider to manage their resource and operational cost. In this paper, the state of art survey has been carried out on recent developments in resource scheduling algorithms for cloud computing. This paper provides the comparative analysis of all the surveyed algorithms in terms of different performance metrics. The observation of the survey provides some research gaps to improve the efficiency of the existing resource management system.

Keywords—Cloud Computing, Resource Scheduling, Performance, Efficiency

I. INTRODUCTION

Cloud computing is a modern technique that utilized in high-performance computational tasks in an easy way. Cloud provides services in much-managed fashion it means that user can access their services and applications as required and avail the facility of pay per use. Cloud computing deals with remote services; provide a facility for cost and datacenters [1]. Cloud computing provides service model like Infrastructure, Platform, and Software services and provides deployment models like Private, Public, Hybrid and Community Cloud and it has following characteristics like self-service, network accessibility, sharing of resources from different servers, measurement services, and elastic services [2].

Basic services

Software as a Service (SaaS): It provides the facility to access or execute the software into cloud infrastructure by the customer. This application can be access from devices like laptop, desktop, Smartphones, and tablets via a web browser or client application. The user does not bother to manage the services as all the basic services provided by the CSP [2].

Platform as a Service (PaaS**)**: Consumer/users can develop software application using programming languages and supporting tools through a service provider, do not need to install any language in the personnel system as well as do not need to worry about the license agreements. The service distributor [2] can do the management of infrastructure used by the consumer.

Infrastructure as a Service (IaaS): The user can access the facility of processing, physical storage, physical networks, servers, and other basics computation resources where they can deploy and run the applications, which include OS and other system software or applications. There is no need to control or manage the infrastructure by the user they may have command over the OS and other layers. [2].

Many more services like storage, communication, and Database etc. managed by the cloud computing and all it comes under above mentioned three services.

Cloud models

Private cloud: Cloud infrastructure can be access by an organization with many consumers. It may be self-governed, operated and managed by the self and or other service provider or can be combine and it may install on similar or other places.

Community cloud: a specific group of the customer from one or any companies that have sharing concepts can use the organizational structure and facilities. It may be self-governed, operated and managed by own and or other service provider or can be combined and it may install same or other places.

Public cloud: common people can openly use the organizational structure and facilities through network. It may be self-governed, operated and managed by the self and or other service provider or can be merge, it may have installed similar or other places, and it is existing on the places where the service provider installed the services.

Hybrid cloud**:** The incorporation of two or more than two cloud infrastructure has some unique entities, but has some

bond by or proprietary technology that ensures the application and data probability [2].

Cloud Characteristics

On-demand self-service**:** A customer can have the facility to compute services such as network and server time, storage as per demand without any interaction of any service provider.

Broad network access: User may have the facilities on the internet and can be used with quality techniques and can use by various client platforms like phones, tablet, smartphones, personal laptops and organizational infrastructure.

Resource pooling: The facilities are on the chain to access many customers the internet and recourse management techniques with different resources that are to be actively assign and re-assigned according to the customer requirements.

Rapid elasticity: Services can be elastic like if a customer needs services X it will be severed, after some time interval if service needed X+1.

Measured service: Cloud computing provides the facility of automatic metering capability for the measurement if service used by the customer so that consumed service can be easily measured as per the use [2].

The first section is all about the introduction of the cloud and its services wherein section two, the detail about scheduling has been discussing. In section three, the different types of resource scheduling algorithms are analysed and compared with their performance metrics, where section four is presenting the findings of this survey and section five conclude this papers objective and outcomes.

II. SCHEDULING

Scheduling can be stated that an event to take place at a particular time. There are many types of scheduling algorithm available in distributed computing for resource scheduling. Many algorithms are to be utilize in the distributed system by appropriate authentication. The purpose of the scheduling algorithm is to achieve maximum throughput. For a cloud environment, the regular approaches are unable to attain the desired efficiency. Cloud computing classified the scheduling algorithms into following categories; Batch/sequential and online/random mode. In batch/sequential mode, all the resources are standing in the chain and formed a set when it arrives at the system. In this, the algorithm will turn on in the fixed time interval. Following are the example of batch mode algorithm: Fcfs, RR, min-min, and max-min.

Cloud computing is an online technology and heterogeneous too so the speed of the processors can be varying into less time span, that's why the online mode of scheduling is more effective and suitable for the cloud.

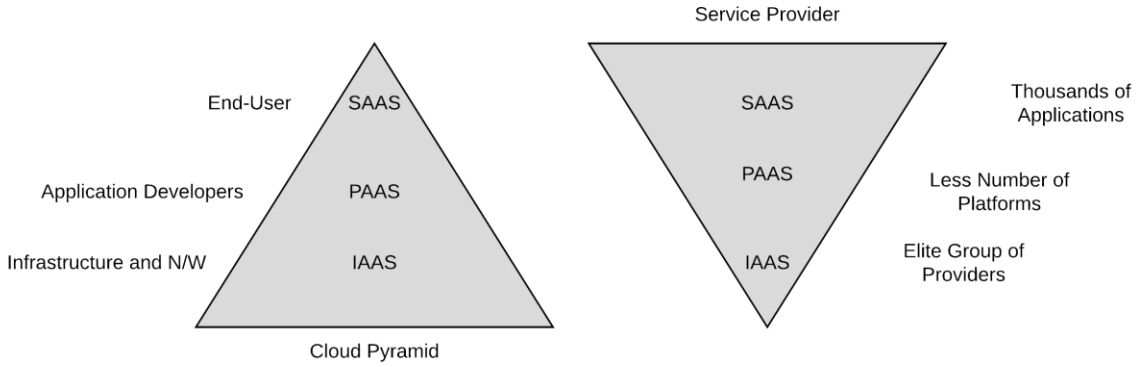

Figure 1. Services of Cloud

III. RELATED WORK

STAR: SLA-aware Autonomic Management: In this paper, authors design an algorithm which name is STAR has been propose for automatic resource scheduling which considers the common property of auto-management. The main purpose to provide STAR is to minimize the SLA violation and enhance the user satisfaction by providing their QoS as required. In this paper author considerations, the following SLA like performance based on cost, latency, execution time, availability and reliability to minimize the SLA violation to satisfied QoS. This algorithm is implement and execute in a real cloud environment at Thapar University and results show the performance for SLA violation is better in terms of existing resource management techniques [3].

Multi-Objective Task Scheduling Algorithm**:** In this algorithm, authors provide the minimum executing time for scheduling task in a cloud environment. They executed the algorithm in a real cloud environment with a single parameter. More QoS parameter can be consider for the

improvement of the system. The proposed calculation gives an ideal booking strategy. The greater part of the calculations plans assignments in light of single criteria (i.e. execution time). Nevertheless, in the cloud condition it is required to consider different criteria like execution time, cost, and data transfer capacity of client and so forth. This calculation is re-enacted utilizing CloudSim test system and the outcome indicates better execution and enhanced throughput. [4].

Dynamic Resource Allocation Scheme: In this paper, the authors proposed a new method for high priority job execution. In this method, the avoiding rule of the new virtual machine for a new job has been achieve The main objective to propose this algorithm was to suspend the low priority job where the high priority job will be allowed to execute in a virtual machine. It is observe that compared with the creation of new virtual machine this method has less overhead [5].

Autonomous Agent-Based Load Balancing: Authors focused on the balancing of the workload in a cloud environment. They have observed that day-by-day cloud user is increasing workload balancing is required to perform efficient scheduling. In this work, they have proposed an automatic load balancing technique with agent-based which can manage the load dynamically in the cloud. The load has been calculate in VM and in DC and if any mismatch obtained then the agent will search the next candidate for VM and DC. According to the experiments done by the authors, it is observe that the proposed algorithm works satisfactorily [6].

Credit-Based Scheduling Algorithm: In this paper, the authors focused on three cloud-scheduling scenarios. The first, based on the length of the tasks. The second, based on the priority of the task. In addition, the proposed approach is considering both cloudlet priority and length [7].

Deadline Based Resource Provisioning and Scheduling Algorithm: In this paper, the authors presented a combined resource provisioning and scheduling strategy for executing scientific workflows on infrastructure as service clouds. Metaheuristic optimization and particle-swarm optimization techniques have been apply to minimize overall execution cost. It covers the basic principles like the pay-as-you-go model, heterogeneity, elasticity, and dynamicity of the resources. It also considered performance variation and VM boot time [8].

Greedy-Based Job Scheduling Algorithm**:** Authors works on user's fairness and efficiency on job scheduling in cloud environments by providing better QoS. In this paper, they have proposed Greedy-Based job scheduling algorithm, which applied to cloud environments. The result indicates that the algorithm has decreased the completion time of submitted jobs and increased user satisfaction [9].

Optimal Algorithm: In this paper authors primarily talk about three calculations and built up another summed up need-based calculation with restricted assignment, future they will take more errand and attempt to diminish the execution time as exhibited and build up this calculation to matrix condition and will watch the distinction of time in cloud a network [10].

Resource-Aware Hybrid Scheduling Algorithm: A hybrid approach is propose for tasks scheduling in HDC considering both tasks and resources clustering; it is based on client scheduling strategies in both the heterogeneity of computing resources and application tasks [11].

Hybrid Job scheduling Algorithm: The authors use the genetic algorithm as basis approach and they modify it with the fuzzy to reduce the iteration of producing the population. They define and design two types of chromosomes with different QoS parameters and with fuzzy, they obtain the fitness value of all chromosomes. The new approach improves system performance in terms of execution cost about 45% and the total execution time of about 50% [12].

Firefly Algorithm: The authors focused on load balancing problem. It deals with the set of requests and servers. The firefly algorithm, because of the attracting features, inspires this. The proposed approach is develop in three steps, index calculation, and schedule list. The experimental result achieves the proposed approach. The achieved time is 0.934 ms [13].

Honeybee Algorithm: In this work, the authors proposed a load balancing technique for cloud computing environments based on the behaviour of honeybee foraging strategy. This does not only work for balance even it works for the priorities of tasks that have been remove from heavily loaded Virtual Machines. This removed task has been treat as the honeybee. Experimental results show that the algorithm stands well without increasing additional overheads. The technique works well on heterogeneous cloud computing systems [14].

IV. SURVEY FINDINGS

The performance of the scheduling algorithm of the cloud is evaluating by its specified performance metrics. They are execution time, cost, power consumption, and SLA violation rate, quality of service, energy, resource cost, and resource utilization. The state of art survey shows that all algorithms approach to improve the efficiency of scheduling techniques manually with few parameters. In fact, a number of service demand increasing the complexity of resource provisioning, to resolve such efficiency issues, an autonomic resource-scheduling framework is required. There are some autonomic frameworks are introduced but still, there is a scope of improvements with multi-objective parameters.

Table 1. An Analysis of different Resource Scheduling Algorithms

Frameworks	Algorithm	Purpose	Parameters	Environment
Star	Based on the generic property of self-management	To reduce SLA-Violation	execution time, cost, latency, reliability	Cloud Environment
Multiple Objective	Task Scheduling Algorithm	To reduce the execution time	execution time	Cloud Environment
Dynamic Resource Allocation Scheme	Resource Scheduling Algorithm	To suspend low priority job and allow high priority job.	Priority-based	Cloud Environment
Autonomous Agent-Based	Load Balancing	Calculation of load on Virtual Machine	Load,	Cloud Environment
Cuckoo	Task Scheduling Algorithm	Scheduling	Execution time	Cloud Environment
Credit-Based Scheduling	Task Scheduling Algorithm	To combine Cloudlet Priority and length mechanism	Cloudlet Priority and length, Makespan	Cloud Environment
Deadline Based Resource Provisioning and Scheduling Algorithm	Resource Scheduling Algorithm, PSO, and MHOA	To minimize execution cost	PSO, MHOA, Execution Cost	Cloud Environment
Greedy-Based Job Scheduling Algorithm	Job Scheduling Algorithm	To decrease the job completion time	execution time	Cloud Environment
Optimal Algorithm	Task Scheduling Algorithm	To observe the difference of time between grid and cloud	execution time	Cloud & Grid Environment
Resource-Aware Hybrid Scheduling Algorithm	Task & Resource Scheduling Algorithm	To minimize execution cost	Dynamic Clustering & Abstract modeling	CloudSim
Hybrid Job Scheduling Algorithm	Job Scheduling Algorithm	It reduces the population	execution time & Cost	Cloud & Fuzzy set
Firefly Algorithm	Load Balancing	To reduce balancing time	Index Calculation, Schedule List, Execution time	Cloud Environment
Honeybee Algorithm	Load Balancing	To balance the load as well as assign the task according to the priority	Priority, Response Time	Cloud Environment
(IDEA) Algorithm	Task & Resource Scheduling Algorithm	To allocate resource & task efficiently	Makespan, Cost, Performance	Cloud Environment

V. CONCLUSION AND FUTURE SCOPE

Resource scheduling in cloud computing is a tool, which affects the operational cost of the service provider and cloud user as well. Many researchers have been carrying out towards resource scheduling in different aspects like load balancing, makespan, workloads priority, resource availability, and cost. In this paper, different resource scheduling frameworks and its techniques have been discussing and observations of this study show that many of this frameworks are not fully automated and on the basis of less number of performance objective function, the resources are scheduled. Due to increasing of service demand, this work also finds that, from the submission of workloads by cloud user to scheduling the resources, and automated approach is required. The automatic resource scheduling for cloud can be achieve by opting self-characteristics methods like self-optimization, healing, protecting and configuring scheme.

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