RESOURCE SCHEDULING IN CLOUD ENVIRONMENT: A SURVEY

Meenakshi Saini[1], Dr. Neeraj Mangla[2]

[1]Ph.D. Research Scholar, Maharishi Markandeshwar (Deemed to be University) Mullana, Ambala, India,

[2]Associate Professor, Maharishi Markandeshwar (Deemed to be University) Mullana, Ambala, India.

Abstract: Cloud computing offers the innovative facilities at a stretch that area unit too engaging for any Cloud user to ignore. With its rising application and popularization, IT firm's area unit are quickly deploying distributed information centres internationally, sitting varied challenges in terms of programming of resources beneath completely different body domains. This viewpoint brings out absolute essential components for economical programming of resources providing a large genre of characteristics, diversity in context of level of service agreements which too with user contingent snap. During this paper, a comprehensive survey of analysis associated with varied aspects of Cloud Resource programming is provided with parameters like Energy potency, Virtual Machine allocation and migration, Cost-effectiveness and Service-Level Agreement is additionally conferred.

IndexTerms: **Resource Scheduling, Cloud Computing, Quality of Service (QoS), Service-Level Agreement (SLA).**

1. INTRODUCTION Cloud Computing is that the new cost-effective computing customary that delivers on-demand access to services on pay-per-usage basis [1]. The unwavering services offered by Cloud Computing area unit accomplished through its innovative world information centres that area unit firmed on virtualized cypher and storage technologies [2]. it's supposed for the Cloud users to multifold the prospects by accessing hired infrastructure and software system ap-plications ubiquitously and non-restrictive in time. The ideology is firmed on the grounds of 're-usability of IT capabilities. the standard computing archetypes become ex by Cloud Computing thanks to its expansive horizons across structure boundaries.

The Cloud Computing paradigm offers varied advantages to each cloud customers and repair suppliers. The aim of service supplier is to maximise the profit by economical usage of its datacentre resources through virtualization technology [3] and effective programming among the constraint of Service-Level Agreement with cloud users and restricted power budget. From the angle of Cloud's user, the main focus is on application performance, handiness of services, cost-effectiveness [4]and adaptableness to the dynamical needs.

The resource programming in Cloud setting is often a sophisticated task thanks to geographical distribution of resources having variable load conditions, completely different user's needs and worth models [5]. plenty of analysis work coping with the Cloud resource programming drawback has been sliced by several researchers [6]. This paper provides a close survey of the prevailing resource programming techniques specializing in the promising options and challenges of Cloud Computing.

2. LITERATURE REVIEW

Resource provisioning counsel that the choice of deployment, and run-time management of package (e.g., direction servers, load balancers) and hardware resources (e.g., CPU, storage, and network) for creating given certain action for applications. This resource provisioning takes Service Level Agreement (SLA) into thought for providing service to the Cloud users. this is often associate degree initial agreement between the Cloud users and Cloud service suppliers that ensures Quality of Service (QoS) parameters like performance, handiness, dependability, time interval etc. within the consequent sections, a classification of the resource programming drawback in Cloud setting as shown in Fig. 1. and its existing accessible solutions are reviewed in short.
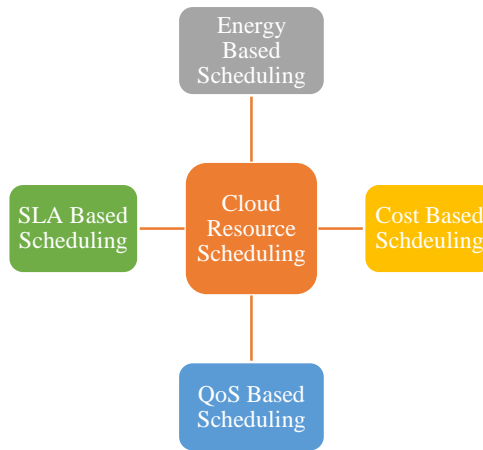
Fig. 1. Resource Scheduling problem in Cloud Computing

Table 1.Comparative Study of Various Cost based Resource Scheduling Techniques

Algorithm & Technique	Parameters of Scheduling	Tools Used	Findings	Environment
Job grouping based dynamic scheduling strategy [10]	Cost, Resource Utilization, Computation Ratio	CloudSim Version 3.0	The projected strategy will cut back the time interval further as price.	Cloud
List scheduling algorithm for heterogeneous computing system [11]	Cost, Makespan, Load balance	CloudSim	The planned formula balances the load and minimize the entire financial value.	Cloud
A task scheduling algorithm based on genetic algorithm and Ant Colony Optimization in Cloud Computing [12]	Cost, Performance, Execution Time	MATLAB	Solve the slow convergence and improve the looking potency of algorithmic program.	Cloud
Credit based scheduling using cost in Cloud Computing [13]	Task length, Task cost Makespan	Simulator	The results show that projected algorithmic program works expeditiously than the others. Makespan of the task is lesser than the value of the task is additionally decreasing.	Not Mentioned
Scheduling cost approach (SCA) in Cloud environment [14]	Cost, Resource Utilization	CloudSim	Proposed algorithmic program improves the load balance and cut back the value of processor, RAM, bandwidth, storage compared to FCFS & SJF algorithmic program.	Cloud
Cost based task scheduling in Cloud Computing [15]	Cost factor, Execution time	CloudSim	The result shows that projected theme maximize the performance with less price issue (234.21) as compared to the basic principle rule (358.13).	Cloud
Improved cost-based algorithm for task scheduling [16]	Cost, Performance	CloudSim	1. Measures each resource price and computation performance. 2. Improve thecomputational-l ratio	Cloud
A PSO based scheduling of workflow on Iaas Clouds [17]	Makespan, Cost	CloudSim	provides higher performance than the opposite similar approaches in terms of meeting applications point in time and generating schedules with lower execution value.	Cloud

2.1 COST BASED SCHEDULING

In Cloud Computing, service suppliers need to attenuate resource rental prices whereas still meeting employment demands and Cloud users forestall to very cheap doable costs for the resources they lease. it's worthy to say that enhance the performance of the Cloud Computing and attain higher turnout in less time by mistreatment correct theright the correct utilization of its virtual machines (VM) residing on information centres and moreover as proper allocation of tasks on them [7]. the kind of allocation of task to VM is static. The performance is measured in terms of value. In [8], authors will highlight the schedule task teams in Cloud Computing platform, wherever resources have completely different resource prices and computation performance. thanks to job grouping, communication of coarse-grained jobs and resources optimizes computation/communication quantitative relation. For this purpose, associate degree algorithmic program supported each price with user task grouping is planned. The planned programming approach in Cloud employs associate degree improved cost-based programming algorithmic program for creating economical

mapping of tasks to offered resources in Cloud. This programming algorithmic program measures each resource value and computation performance, it additionally improves the computation and communication quantitative relation by grouping the user tasks in line with a specific Cloud resource's process capability and sends the sorted jobs to the resource. In [9], authors conferred a unique hybrid algorithmic program, known as Chemical Reaction – Ant Colony (CR-AC), combining each the Chemical Reaction Optimization (CRO) and Ant Colony Optimization (ACO) algorithms to resolve the workflow-scheduling drawback. The planned CR-AC algorithmic program is enforced within the CloudSim toolkit and evaluated by mistreatment real applications and Amazon EC2 evaluation model. Moreover, the results area unit compared with the foremost recent algorithms: modified Particle Swarm Optimization (PSO) and Cost-Efficient Genetic Algorithmic program (CEGA). The experimental results indicate that the CR-AC algorithmic program achieves higher results than the standard CRO, the ACO, the modified PSO and CEGA algorithms, in terms of total value, time quality, and schedule length. Table 1.Elucidates a comparative study of various Cost based Scheduling Techniques.

Table 2. Comparison of Various QoS based Resource Scheduling Techniques

Algorithm & Technique	Parameters of Scheduling	Tools Used	Findings	Environment
A novel QoS guided task scheduling algorithm for grid computing [21]	QoS, Performance, Resource Utilization, Makespan	Simulator	Results shows that the new approach will result in important performance gain for a range of applications.	Not Mentioned
A QoS based scheduling algorithm for instance-intensive workflows in Cloud environment [22]	QoS, Workflow, Deadline allocation	CloudSim	Simulation results shows that, QDA algorithmic rule will higher meets the various necessities from users and additionally encompasses a far better load equalisation rate.	Cloud
QoS based task scheduling algorithm in Cloud Computing [23]	QoS, Execution time, Makespan, Resource Utilization		Improves the potency of the QoS considering factors inbound time of the task, time taken by the task to execute on the resource and therefore the value in use for the communication.	Cloud
QoS – Driven task scheduling [24]	Makespan, Average Latency	CloudSim	Uses many QoS parameters to assign priority to tasks on resources that take minimum time as possible.	Cloud
QoS aware workflow scheduling (WFS) in Cloud Computing [25]	QoS, Optimization, Workflow	WorkflowSim	The result shows the varied aspects of progress sorts, QoS constraints, WFS schemes still as their categorization into heuristic, meta-heuristic and hybrid schemes.	Cloud
A deadline constrained scheduling algorithm for Cloud Computing system based on the driver of dynamic essential path [26]	Deadline, Cost	MATLAB	Proposed resolution providing lower time complexness and also the performance of the planned formula is much better.	Cloud
Cost based multi QoS job scheduling [27]	Cost, Time	Numerical Simulation	The planned approach equally distributing the load among the present machine. So that, the full completion time of tasks is reduced.	Cloud

2.2 QoS BASED SCHEDULING

The Cloud service suppliers unceasingly attempt to enhance Cloud management tools to ensure the specified QoS and supply users the services with prime quality. one in all the foremost necessary management tools that play an important role in enhancing QoS is programming. programming is that the method assignment users' tasks into offered Virtual Machines (VMs). In [18], authors planned a multi-layer QOS primarily based Task programming algorithmic program for Cloud computing. Firstly, so as to replicate the precedence relation of tasks, the planned algorithmic program computes the priority of tasks in line with the special attributes of tasks by native programming agent, then kinds tasks by priority. Secondly, the algorithmic program evaluates the completion time of every task on completely different services, and schedules every task onto a service which may complete the task as shortly as doable in line with the sorted task queue. In [19], authors planned a unique Network aware QoS advancement programming methodology for Grid Services. The planned programming algorithmic program considers network and QoS constraints. The goal of

the planned programming algorithmic program is to implement the advancement schedule so it reduces execution time and resource value and nonetheless meets the point in time obligatory by the user. The experimental result shows that the planned algorithmic program improves the success quantitative relation of tasks and turnout of resources whereas reducing makespan and advancement execution value. In [20], authors devised differing kinds of task programming algorithms with QoS facility and problems associated with them in Cloud Computing. These programming algorithms specialise in resource management, time interval, load balancing and performance. Comparison of various QoS based Resource scheduling Techniques is presented in Table2.

2.3 SLA BASED SCHEDULING

In Cloud setting, the services area unit provided by Cloud service supplier or by Cloud vendors. To access the resource the tip user and also the Cloud service supplier should build a covenant with one another. Service Level Agreement (SLA) could be a legal agreement signed between the client and also the service supplier that ensures the Quality of Service (QoS) parameters like information storage, handiness of the system mainframe, and network.

Table 3. Comparison of Various SLA based Resource Scheduling Techniques

Algorithm & Technique	Parameters of Scheduling	Tools Used	Findings	Environment
SLA aware application deployment and resource allocation in Cloud [31]	SLA violation rate, Resource Utilization	CloudSim	The heuristic design and implementation and present detailed evaluations as a proof of concept emphasizing the performance of the approach	Cloud
SLA based resource allocation for software-as-a-service provider (SAAS) in Cloud Computing [32]	SLA violation rate, Cost	CloudSim	Proposed solution minimizes the Saas providers cost and the number of SLA violation in a dynamic resource sharing Cloud environment	Cloud
SLA base d admission control for a software-as-a-service provider in Cloud [33]	Cost, SLA violation	CloudSim	Simulation result shows that the proposed algorithm provide substantial improvement (up to 40% cost saving)	Cloud
SLA based resource provisioning for Hosted software-as-a-service applications [34]	Cost, SLA violation	CloudSim	The proposed algorithm reduces the total cost up to 54% and the number of SLA violations up to 45%	Cloud
Optimized SLA based workload balancing strategy [35]	QoS, Load Balancing, Resource Utilization	CloudSim	Proposed algorithm provides good response time, reduces waiting time, effective utilization of resources and achieves better load balancing among the server	Cloud
SLA based resource scheduling for big data analytics as a service [36]	Cost, Efficiency	CloudSim	Proposed solution provides the efficiency of the algorithm in SLA guarantee, profit enhancement, and cost saving	Cloud
Self- governing SLA management with resource conciliation and allocation [37]	Cost, SLA violation rate, Energy efficiency	CloudSim	Simulation result with extra CPU power of 100 MIPS have shown better results the average rate of SLA violation is reduced to 10.5%, ROI is decreased to 0.68%	Cloud
Automatic service selection for multi Cloud environment while adhering to SLA claimed by Saas providers [38]	Service Ranking	JavaBase Simolator	This approach selects best plausible set of services satisfying SLA parameters. It helps in maintain SLA claims of the Saas providers	
Adaptive Schedular based on negotiation [39]	SLA violation rate	Hadoop	The analytical study in Hadoop have delivered better resource distribution, priority basis allocation, availability.	

In [28], authors proposing SLA and cost-aware resource provisioning and task programming approach tailored for giant information applications within the Cloud. Current approaches assume that information is pre-stored in cluster nodes before preparation of huge information applications. additionally, their focus is only on task programming, and not virtual machine provisioning. In [29], authors planned SLA-based involuntary resource management technique sensible through antlion optimisation algorithmic program to maximise the resource utilization supported SLA and QoS satisfaction. The execution time, value and SLA violation rate, objective functions computed for this framework and compare with two existing frameworks. The framework is implements in

CloudSim toolkit and also the results recorded the utmost performance. The experimental results make sure that value, execution time, and resource value area unit increasing whereas SLA violation rate is increasing. In [30], authors extend SLA specification to deal with the specificity of federation and its constraints and additionally, planned an observation model that handles the quality of managing a Multi-level observation and planned an answer to mitigate the cascading impact thanks to SLAs observation. observation theme has the potential of with efficiency reportage the supply of performance violations, and its propagation to all or any dependent Cloud services. Comparison of various SLA based Resource scheduling Techniques is presented in Table3.

3. CONCLUSION

Resource scheduling forever remained associate degree active space of analysis thanks to world-wide uncontrolled growth of datacentres to cope up with the growing demands of Cloud infrastructure. supported the literature survey, the challenges exhibit by the cloud setting itself in terms of high-octane energy consumption of information centres, shopper satisfaction, supplier profit etc. area unit known. moreover, an essential analysis of the present on-hand Cloud resource programming techniques on the idea of chosen parameters from the literature is administrated. With a belief, that associate degree up-to-date review of the resource programming literature conferred during this paper can for certain facilitate the researchers and developers in choosing the foremost applicable techniques to manage resources in Cloud setting beneath the given constraints.

REFERENCES

1. S. Singh, I. Chana. A survey on resource scheduling in Cloud Computing: Issues andChallenges. J Grid ComputingSpringer Science+Business Media Dordrecht. 2016, February, 217-264.

2. W. A. Elkhalik, A. Salah, I. El-Henawy. A survey on Cloud Computing scheduling Algorithms. In International journal of engineering trends and technology (IJETT). 2018, June, 65-70.

3. Y. Demchenko, J. H. D. Van, V. Yako-Venko, C. De Laat, M. Ghijsen, M. Cristea. On-demand provisioning of Cloud and Grid based infrastructure services for collaborative projects and groups. In Collaboration technologies and systems (CTS), International Conference, IEEE. 2011, May, 134-142.

4. R.Buyya, S.C. Yeo, S. Venugopal, J. Broberg& I. Brandic. Cloud Computing and emerging IT platforms: Vision, hype and reality for delivering Computing as the 5th utility. Future generation Computing system. 2009, June, 599-616.

5. H. Mehta, V. K. Prasad, Dr. M. Bhavsar. Efficient resource scheduling in Cloud Computing. In International journal of advanced research in computer science. 2017, April, 809-815.

6. B.K. Dewanagan, A. Agarwal, M. Venkatadri, A. Pasricha. Resource scheduling in Cloud: A comparative study. In International journal of computer science and engineering (JCSE). 2018, August, 168-173.

7. S. Garg, K. Govil, B. Singh. Cost based task scheduling algorithm in Cloud Computing. In 3rd International conference on system modeling& advancement in research trends (SMART). 2014, 411-414.

8. S. Selvarani, Dr. G. S. Sadhasivam.Improved cost-based algorithm for task scheduling in Cloud Computing in IEEE. 2010.

9. A. A. Nasar, N. A. El-Bahnasawy, G. Attiya, A. El-Sayed. Cost effective algorithm for workflow scheduling in Cloud Computing under deadline constraint. In Arabian journal for science and engineering. 2018, December.

10. Y. Chawla, N.Bhonsle. Dynamically optimized cost-based task scheduling in Cloud Computing. In International journal of engineering trends & technology in computer science (IJETTCS). 2013, June, 38-42.

11. D. I. G. Amalarethinam, T. L. A. Beena. Customer facilitated cost-basedscheduling (CFCSC) in Cloud. In International conference on information and communication technologies (ICICT). 2014, 660-667.

12. C. Liu, C. Zou Pei WU. A task scheduling algorithm based on genetic algorithm and Ant
Colony optimization in Cloud Computing. In 13th International symposium on distributed Computing and applications to business, engineering and science, IEEE. 2014, December, 68-72.

13. D. Jain, Dr. A. S. Goutam. Credit based scheduling using cost in Cloud Computing. In International journal of innovative research in computer and communication engineering. 2017, May, 10422-10426.

14. M. A. Alwarafi, A. Dhari, A. A. Al-Hashmi, B. Darem. Cost aware task scheduling in Cloud Computing environment. In I. J. computer network and information security. 2017, May, 52-59.

15. S. Sharma, Dr. S. Tyagi. Cost based task scheduling in Cloud Computing. In International research journal of engineering and technology (IRJET). 2017, July, 694-699.

16. S. Saxena, Dr. R. K. Mishra, Dr. M. Aggarwal. A comparative study on scheduling algorithms in Cloud Computing. In International journal of advanced research in computer engineering (IJARCET). 2018, January, 19-24.

17. M. A. Rodriguez, R. Buyya. Deadline based resource provisioning and scheduling algorithm for scientific workflows on Clouds. Cloud Computing, IEEE Transactions on. 2014, April, 222-235.

18. M. N. Faruk, Dr. D. Sivakumar. Multi-layer QoS based task scheduling algorithm for Cloud environments. In 4th national conference on advanced computing, applications & technologies. 2014, May, 1-7.

19. S. John, M. Mohamed. A network performance aware QoS based workflow scheduling for Grid services. In International Arab journal of information technology. 2018, September, 894-903.

20. R. Patel, H. Mer. A. survey of various QoS based task scheduling algorithm in Cloud Computing environment. In International journal of science & technology research. 2013, November, 109-112.

21. HEXiaoshan, X. Sun, G. V. Laszewski. QoS guided min-min heuristic for grid task scheduling. In journal of computer science and technology. 2013, May, 1-16.

22. H. Li, S. Ge, Lu. Zhang. A QoS based scheduling algorithm for instance-intensive workflows in Cloud environment. In 26th Chinese control and becision conference (CCDC) IEEE, 2014, 4094-4099.

23. S. Potlusi, K. S. Rao. Quality of Service (QoS) based task scheduling algorithms in Cloud Computing. In International journal of electrical and computer engineering (IJECE). 2017, April, 1088-1095.

24. S. Varshney, S. Singh. A survey on resource scheduling algorithms in Cloud Computing. In International journal of applied engineering research. 2018, November, 6839-6845.

25. S. Kaur, P. Bagga, R. Hans, H. Kaur. Quality of Service (QoS) aware workflow scheduling (WFS) in Cloud Computing: A systematic review. In Arabian journal for science and engineering. 2018, November, 2867-2897.

26. X. Shao, Z. Xie, Y. Xin, J. Yang. A deadline constrained scheduling algorithm for Cloud Computing system based on the driver of dynamic essential path in journal. pone.0213234. 2019, March, 1-26., ICC. Procedia computer science.

27. M. Abdullah, M. Othman. Cost based multi-QoS job scheduling using divisible load theory in Cloud Computing. In international conference on computational science. 2013, 928-935.

28. M. Alrokayan, A. V. Dostjerdi, R. K. Buyya. SLA-aware provisioning and scheduling of Cloud resources for big data analytics. Available at: https://github.com/Cloudslab/CloudSimEx/tree/Master/Cloudsimex-mapreduce.

29. B. K. Dewangan, A. Agarwal, M. Venkatadri, A. Pasricha. SLA based automatic Cloud resource management framework by antlion optimization algorithm. In International journal of innovative technology and exploring engineering (IJITEE). 2019, February, 119-123.

30. A. A. Falasi, M. A. Serhani, R. Dssouli. A model for multi-levels SLA monitoring in federated Cloud environment. In IEEE 10thinternational conference on Ubiquitours intelligence & Computing and 10th international conference on autonomic & trusted Computing. 2013, 363-370.

31. V. C. Emeakaroha, I. Brandic, M. Maurer, I. Breskovic. SLA-aware application deployment and resource allocation in Clouds. In 35th IEEE annual computer software and applications conferences workshops. 2011, 298-303.

32. L. Wu, S. K. Garg, R. K. Buyya. SLA based resource allocation for software-as-a-service provider (Saas) in Cloud Computing environments. In 11th IEEE/ACM international symposium on Cluster, Cloud and Grid Computing. 2011, 195-204.

33. L. Wu, S. K. Garg, R. K. Buyya. SLA based admission control for a software-as-a-service provider in Cloud Computing environments. In journals of computer and system sciences. 2012, December, 1280-1299.

34. L. Wu, S. K. Garg, S. Versteeg, R. K. Buyya. SLA based resource provisioning for hosted software-as-a-service applications in Cloud Computing environments. In IEEE Transactions on services Computing

35. B. S. Rajeshwari, Dr. M. Dakshayini. Optimized service level agreement (SLA) based workload balancing strategy for Cloud environment. In IEEE international advance Computing conference (IACC). 2015, 160-165.

36. Y. Zhao, R. N. Calheiros, G. Gange, K.Ramamohanarao, R. K. Buyya. SLA based resource scheduling for big data analytics as a service in Cloud Computing environments. In 44th international conference on parallel processing. 2015, 510-519.

37. R. Anita, Dr. C. V. Raj. A comprehensive survey on SLA compliant energy aware resource allocation in Cloud datacentres. In international journal of engineering research in management & technology. 2017, June, 335-349.

38. S. Farokhi, F. Jrad, I. Brandic, A. Streit. A HS4MC-Hierarchical SLA based service selection for multi Cloud environments. In: CLOSER 2014, 722-734.

39. D. Nayak, V. S. Martha, D. Threm, S. Ramaswamy, S. Prince, G. Fatimberger. Adaptive scheduling in the Cloud-SLA for Hadoop job scheduling. In science and information conference (SAI), IEEE. 2015, July, 832-837.