Cloud Scheduling using PSO based on memory management for enhancing the cloud efficiency

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***Abstract*—Cloud computing is a good way for distributing services in healthcare services, administrations, social insurance research etc. In this paper PSO (Particle swarm optimization) and RASA (Resource Awareness Scheduling Algorithm) are compared to each other for various parameters including energy, performance and throughput. PSO has been designed and compared in such a way that the new future developments can easily be differentiated and compared to existing PSO algorithm and its benefits can easily be recognized.**

Keywords*—*Cloud Computing, Resource Scheduling, Resource Provisioning, PSO,RASA.

I. INTRODUCTION

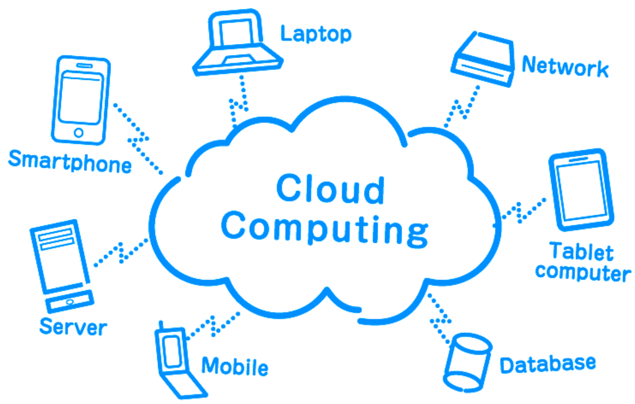
Cloud computing relies on sharing of resources to achieve coherence and economies of scale similar to a utility over a network. Cloud Computing is getting popular every day. Cloud service providers provide services to large scale cloud environment with cost benefits. Also, there are some popular large scaled applications like social networking and internet commerce. These applications can provide benefit in terms of minimizing the costs using cloud computing. Cloud computing is considered as internet-based computing service provided by various infrastructure providers based on their need, so that cloud is subject to Quality of Service (QoS), Load Balance (LB) and other factors which have direct effect on user consumption of resources controlled by cloud infrastructure [1].

In Cloud scheduling process need to achieve several factors. So, it needs to use the effective algorithm for allocating proper task to the proper resources. Various task scheduling algorithms has been proposed, most important task scheduling algorithms are Min-min, Max-min, RASA, etc.

A cloud system is so complex due to its unpredictable environment. It is extremely challenging to obtain accurate information on the state of the system. Moreover, it contains large resources which are shared and require complex policies to manage them. The factors affecting the resource management in cloud are performance, functionality and cost. Resource management in cloud computing is associated with fluctuating workloads which pose a major Challenge to elasticity of cloud computing. The situation for fluctuation can be of two ways. One is a planned spike and the other is an unplanned spike in workloads. For the first case, the situation can be predicted in advance and resource allocation can be done in advance. For the second case, resources have to be allocated on demand and reallocated when needed. This is called Auto-scaling in cloud computing. This shows that the policies for resource management for cloud computing is different from the policies for traditional systems. The general policies to be considered in cloud resource management are Admission control: takes decision whether to admit a job/request to be processed in the cloud, Resource allocation: provisions Virtual Machines (VMs) onto Physical Machines (PMs) and jobs onto VMs, Quality of Service (QoS): refers to metrics like response time, operational cost, throughput, maximization of profit and so on, Workload balancing: load balancing of jobs between the resources so as to improve its utilization, Energy Management: refers to optimized use of energy in the datacenter [5]. Resource allocation in cloud can be classified into two types:

First is Mapping of Virtual Machines (VMs) onto Physical Machines: Resources of cloud include the software and hardware required to execute user workloads. Examples of such resources are memory, CPU, bandwidth, storage and network. Resource allocation is the process of allocating optimal resources to the jobs requested by the user, so these jobs can be processed efficiently. In a cloud environment, resource allocation generally means allocating a Virtual Machine satisfying the configurations specified by the user. The configurations include the operating system, MIPS, network bandwidth, storage and so on. This method of allocation can be referred as mapping of VMs onto Physical Machines [3].

Second is Mapping of Workloads onto VMs: There is another situation where the cloud contains a set of existing Virtual Machines and a built environment with predefined memory, CPU and bandwidth. The users submit their workloads which may be time varying and deadline based. These workloads need to be allocated to the optimal resources such that the workloads are processed efficiently. This type of allocation is referred as mapping of workloads onto VMs. This article presents a discussion on various issues and challenges of resource allocation in cloud computing. Research issues include resource provisioning, job scheduling, resource overbooking, scalability, pricing, load balancing, multi-tier applications, availability, overheads in network I/O workloads and Quality of Service (QoS) constraints. Open challenges in resource management for cloud are also listed.



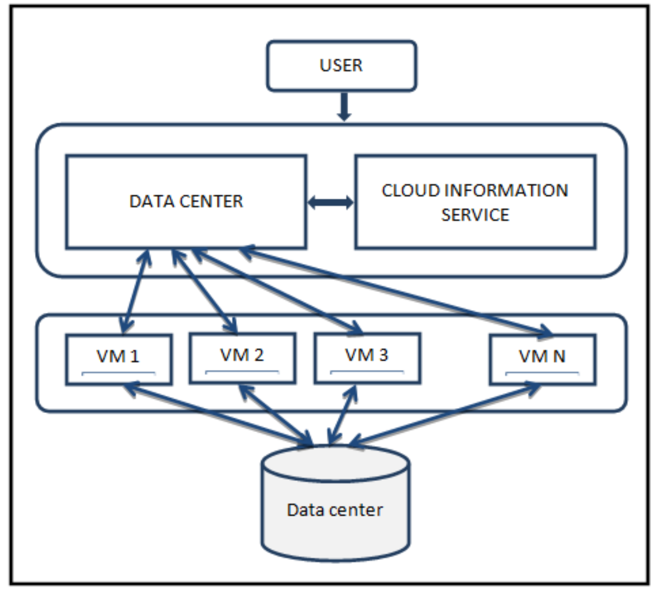
II. Problem Statement

In current paper that have taken min-min and max-min algorithm. Based on these they have developed the new enhanced algorithm as RASA (resource awareness scheduling algorithm). In this process they have awareness of the resource completion speed. Such that large tasks that requires larger execution time will be put to the slower resources. On the other hand, smaller tasks are allocated to the faster resources. so that over all waiting time can be reduced. In current research they have compared this to the existing max-min and min-min algorithms. such that the performance can be enhanced. As it is very difficult to know the execution speed of the resource for given process.

In our research we will be using genetic algorithm. Which can be further used for identifying the optimal mechanism for execution of the processes. So that performance can be further enhanced. And compare this to the RASA (Resource Awareness Scheduling Algorithm).

III. Scheduling Process in Cloud

The main advantage of job scheduling algorithm is to achieve a high-performance computing and the best system throughput. The available resources should be utilized efficiently without affecting the service parameters of cloud. Scheduling process in cloud can be categorized into three stages they are Resource discovering and filtering, Resource selection, and Task submission [10]. In resource discovery datacenter broker discovers the resources present in the network system and collects status information related to them. During resource selection process target resource is selected based on certain parameters of task and resource. Then during task submission task is submitted to the selected resource.



IV. Literature Review

Shuibing He, Yang Wang (2016) et al: In this paper, they have considered to improve scientific workflows in cloud environments where data transfers between tasks are performed via provisioned in-memory caching as a service, instead of relying entirely on slower disk-based file systems. However, this improvement is not free since services in the cloud are usually charged in a "pay-as-you-go" model. To further show the values of this concept, we also implement these algorithms and apply them, through a simulation study, to improve deadlock resolutions in workflow-based workloads when memory resources are constrained [1].

S.Devipriya (2013) et al: Cloud computing is the use of computing resources that are delivered as a service over a network. It supplies a high-performance computing based on protocols which allows shared computation and storage over long distances. In cloud computing, many tasks need to execute at a time by the available resources in order to achieve better performance, minimum completion time, shortest response time, resource utilization etc. [2].

Hitoshi Matsumoto (2011) et al: Two mechanisms of cooperative PSO and CPSO are analyzed and the load-balance requirement of equipotent CPSO mechanism was discussed. Then the CPSO load-balance architecture was set up, control parameters were chosen, and the criterion of PSO convergence degree was established. Finally, the control strategy for CPSO' load-balance was proposed. Two tests show that the proposed technique improved the CPSO in precision and efficiency [3].

Pankaj Arora (2012) et al. proposed a Set-Based PSO approach. It tackles a cloud workflow scheduling problem which enables users to define various Qos constraints like deadline constraint, budget constraint and reliability constraint in. It enables users to specify one preferred Qos parameter as the optimization objective. Defined penalty-based fitness functions to address multiple Qos constraints and integrate S-PSO with seven heuristics. A discrete version of Comprehensive Learning PSO algorithm based on S-PSO is implemented [4].

Shaminder Kaur (2012) et al. Discussed cloud computing is the use of computing resources that are delivered as a service over a network. In cloud computing, many tasks need to execute at a time by the available resources to achieve better performance, minimum completion time, shortest response time, resource utilization etc. Because of these different factors, an Improved Max-min algorithm is designed to outperform scheduling process of RASA in case of total complete time for all submitted jobs. So, the scheduling tasks within cloud environment using Improved Max-min can achieve lower make span rather than original Max-min [5].

Rajesh Piplode (2012) et al: An optimal power flow model was established for Available Transfer Capability (ATC) under the static security constraints. The maximum active power of all load nodes in receiving area was taken as objective function. To aim at the low accuracy and premature convergent in ATC optimization algorithms, the chaos cloud particle swarm algorithm based on golden section evaluation criteria (CCGPSO) was proposed. This method divided the particle swarm into standard particle, chaos cloud particle and cloud particle, which used the golden section judge principle according to fitness level. Every sub-swarm particle had respective different algorithm operations [6].

Vignesh V (2013) et al. Discussed resource management is the primary issue as the demand grows for provisioning resources and computation in cloud systems. It presents various research issues pertaining to the management of cloud resources while a comparison is made between existing resource allocation systems. The issues and challenges discussed are resource provisioning, job scheduling, load balancing, scalability, pricing, energy management and availability [7].

Hongsheng Su (2013) et al. Literature meaning of cloud computing is distributed computing, storing, sharing and accessing data over the Internet. It provides a pool of shared resources to the users available on the basis of pay as you go service, means users pay only for those services which are used by him according to their access times. The data processing and storage amount is increasing quickly day by day in cloud environment. This leads to an uneven distribution of overall work on cloud resources. So, a proper balance of overall load over the available resources is a major issue in cloud computing paradigm. Load balancing ensures that no single node will be overloaded and used to distribute workload among multiple nodes. It helps to improve system performance and proper utilization of resources. It also minimizes the time and cost involved in such big computing models. Load balancing and better resource utilization is provided by many existing algorithms [8].

Yi Zhang (2015) et al: Based on the study of traditional min-min scheduling algorithm, the paper proposed a min-min task scheduling algorithm based on QOS constraints in cloud computing. According to the vector which is generated by QOS parameters, the algorithm processes the matching of resources and tasks, and then provides users with resources which meet their requirements. Experimental results show that the min-min task scheduling algorithm for cloud computing has better performance in such aspects as task execution time, rate of discarding task and QOS satisfaction compared with traditional min-min scheduling algorithm [9].

Anterpreet Kaur (2015) et al: Over the years, distributed environments have evolved from shared community platforms to utility-based models; the latest of these being Cloud computing. This technology enables the delivery of IT resources over the Internet and follows a pay-as-you-go model where users are charged based on their usage. There are various types of Cloud providers each of which has different product offerings. They are classified into a hierarchy of as-a-service terms: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). There is a mass of researches on the issue of scheduling in cloud computing, most of them, however, are about workflow and job scheduling. A cloud workflow system is a type of platform service which facilitates the automation of distributed applications based on the novel cloud infrastructure. Many scheduling policies have been proposed till now which aim to maximize the amount of work completed while meeting QoS constraints such as deadline and budget. However, many of them are not optimal to incorporate some basic principles of Cloud Computing such as the elasticity and heterogeneity of the computing resources. Therefore, there work focuses on studying various problems and issues related to workflow scheduling [10].

Nima Jafari Navimipour (2015) et al: Cloud computing is the latest emerging trend in distributed computing, where shared resources are provided to end-users in an on-demand fashion that brings many advantages, including data ubiquity, flexibility of access, high availability of resources, and flexibility. The task scheduling problem in Cloud computing is an NP-hard problem. Therefore, many heuristics have been proposed, from low level execution of tasks in multiple processors to high level execution of tasks. In this paper, a new evolutionary algorithm is proposed which named CSA to schedule the tasks in Cloud computing. CSA algorithm is based on the obligate brood parasitic behavior of some cuckoo species in combination with the Lévy flight behavior of some birds and fruit flies. The simulation results demonstrated that when the value of Pa is low, the speed and coverage of the algorithm become very high [11].

A performance analysis of load balancing algorithms in Cloud environment Computer Communication and Informatics (ICCCI), 2015 International Conference on 8-10 Jan 2015 Load Balancing is essential for efficient operations in distributed environments. As Cloud Computing is growing rapidly and clients are demanding more services and better results, load balancing and task scheduling for the Cloud has become a very interesting research area. Here in this paper, it was investigated the different algorithms proposed to resolve the issue of load balancing and task scheduling in Cloud Computing. The goal is to help in developing a new algorithm after studying almost all available algorithms [12].

Task Scheduling on the Cloud with Hard Constraints Services (SERVICES), 2015 IEEE World Congress on 27 June to 2 July 2015 Scheduling Bag-of-Tasks (BoT) applications on the cloud can be more challenging in order to keep the overall execution costs low. The research in this paper is motivated to investigate task scheduling on the cloud, given two hard constraints based on a user-defined budget and a deadline. A heuristic algorithm is proposed and implemented to satisfy the hard constraints for executing the BoT application in a cost-effective manner. The proposed algorithm is evaluated using four scenarios that are based on the trade-off between performance and the cost of using different cloud resource types. The experimental evaluation confirms the feasibility of the algorithm in satisfying the constraints. The key observation is that multiple resource types can be a better alternative to using a single type of resource [13].

Resource allocation issues and challenges in cloud computing Recent Trends in Information Technology (ICRTIT), 2014 International Conference on 10-12 April 2014 Resource management is the primary issue as the demand grows for provisioning resources and computation in cloud systems. This article presents various research issues pertaining to the management of cloud resources while a comparison is made between existing resource allocation systems. The issues and challenges discussed in this paper are resource provisioning, job scheduling, load balancing, scalability, pricing, energy management and availability [14].

Improved Max-min heuristic model for task scheduling in cloud Green Computing, Communication and Conservation of Energy (ICGCE), 2013 International Conference on 12-14 Dec 2013 Cloud computing is the use of computing resources that are delivered as a service over a network. In cloud computing, many tasks need to execute at a time by the available resources in order to achieve better performance, minimum completion time, shortest response time, resource utilization etc [4]. Because of these different factors, an Improved Max-min algorithm is designed to outperform scheduling process of RASA in case of total complete time for all submitted jobs. So, the scheduling tasks within cloud environment using Improved Max-min can achieve lower make span rather than original Max-min [15].

Task Scheduling in cloud computing International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), June 2015 Cloud computing system is a virtual pool of resources which are provided to users via Internet. It gives users virtually unlimited pay-per-use computing resources without the burden of managing the underlying infrastructure. One of the goals is to use there sources efficiently and gain maximum profit. Scheduling is a critical problem in Cloud computing, because a cloud provider has to serve many users in Cloud computing system. So scheduling is the major issue in establishing Cloud computing systems. The scheduling algorithms should order the jobs in a way where balance between improving the performance and quality of service and at the same time maintaining the efficiency and fairness among the jobs. This paper aims at studying various scheduling methods [16].

Efficient Resource Management for cloud computing environments Pervasive Technology Institute Indiana University Bloomington, IN USA And Rochester Institute of Technology Rochester, NY USA Many advanced features of Cloud computing like reshaping the field of distributed systems and fundamentally changing how businesses utilize computing today it still has some short comings such as the relatively high operating cost for both public and private Clouds. The area of Green computing is also becoming increasingly important in a world with limited energy resources and an ever-rising demand for more computational power. In this paper a new framework is presented that provides efficient green enhancements within a scalable Cloud computing architecture. Using power aware scheduling techniques, variable resource management, live migration, and a minimal virtual machine design, overall system efficiency will be vastly improved in a data center-based Cloud with minimal performance overhead [17].

V. RESULT AND DISCUSSION

In current research the improvement over to the RASA algorithm has been done. In previous research resource awareness is performed. This resource awareness is to know the resource current status before being allocated to the process. in current research based on the PSO optimal resource is identified. Which is better ways of making cloud scheduling efficient.

5.1 RASA Implementation

Start Time	Finish Time(Ms)	Power Consumption(Joule)	Throughput(per second)	processor utilization (Ms)
0	297	17.888	13.88854356	287
0	282	17.888	17.88854356	314
0	289	17.888	13.88854356	222
0	280	17.888	13.88854356	291
0	262	17.888	16.88854356	225
0	246	17.888	13.88854356	316
0	251	17.888	15.88854356	311
0	228	17.888	16.88854356	287
0	221	17.888	15.88854356	221
0	309	17.888	15.88854356	303
200	457	17.888	14.88854356	231
200	438	17.888	16.88854356	264
200	434	17.888	13.88854356	267
200	484	17.888	15.88854356	259
200	490	17.888	14.88854356	245
200	458	17.888	15.88854356	274
200	446	17.888	13.88854356	299
200	462	17.888	13.88854356	290
200	465	17.888	17.88854356	271
200	513	17.888	13.88854356	280
0	314	17.888	17.88854356	286
0	228	17.888	17.88854356	317
0	254	17.888	14.88854356	282
0	289	17.888	14.88854356	253
0	292	17.888	14.88854356	315
0	239	17.888	13.88854356	245
0	271	17.888	16.88854356	248
0	249	17.888	17.88854356	235
0	293	17.888	17.88854356	222
0	298	17.888	13.88854356	300
200	425	17.888	17.88854356	294
200	480	17.888	13.88854356	227

200	421	17.888	14.88854356	260
200	470	17.888	17.88854356	288
200	457	17.888	13.88854356	300
200	484	17.888	15.88854356	282
200	459	17.888	13.88854356	276
200	439	17.888	13.88854356	243
200	452	17.888	13.88854356	256
200	456	17.888	16.88854356	250

Table 5.1 RASA implementation Results

This table shows the cloud implementation performance parameters. These performance parameters include throughput, Power Consumption, Throughput and processor utilization. It is based on RASA algorithm.

5.2 PSO Implementation

Start Time(Ms)	Finish Time(Ms)	Power Consumption(Joule)	Throughput(per second)	processor utilization(Ms)
0	302	16.124516	17.84555749	299
0	219	17.66352	18.11643349	233
0	250	16.462078	19.43861511	219
0	266	16.124516	18.84555749	218
0	246	15.652476	19.44404947	286
0	242	16.093477	18.88383213	277
0	239	15.394804	20.78623411	268
0	222	16.852299	16.98850744	265
0	213	16.703293	17.15789916	296
0	214	17.117243	18.69459956	287
200	471	17.20465	17.59962183	201
200	453	15.652476	19.44404946	309
200	420	17.464249	17.32314726	217
200	489	16.763054	18.08960038	251
200	402	16.911535	17.92199584	222
200	448	15.779734	20.27917624	270
200	446	16.673332	19.19232435	308
200	463	17.14643	18.66277805	285
200	433	15.905973	18.11822799	312
200	478	15.996685	20.1925182	279
0	234	15.066519	20.23914652	319
0	236	17.262676	17.53710257	222

0	239	17.776388	16.00140709	211
0	268	16.852299	18.98850744	291
0	283	15.556349	20.5703796	243
0	308	17.406895	18.3835202	217
0	263	15.491934	18.6559106	298
0	202	16.492422	18.40285047	315
0	232	17.720045	18.05864479	289
0	234	15.264338	18.963897	221
200	495	17.175564	18.63112055	220
200	441	17.521416	17.2633644	236
200	502	15.459625	19.69907872	244
200	406	17.58722	17.75873283	302
200	479	15.6205	18.48590045	305
200	489	15.9687195	19.0391772	231
200	416	16.822603	18.02202624	223
200	440	15.874508	19.15810517	239
200	501	17.117243	18.69459956	313
200	466	17.888544	17.88854355	299

Table5.2 PSO implementation results

This table shows the various performance parameters reading like throughput, power consumption, Processor utilization under PSO.

5.3 Comparison of Power for RASA and PSO

Power Consumption of PSO(j)	Power Consumption Of RASA(j)
16.124516	17.888
17.66352	17.888
16.462078	17.888
16.124516	17.888
15.652476	17.888
16.093477	17.888
15.394804	17.888
16.852299	17.888
16.703293	17.888
17.117243	17.888
17.20465	17.888
15.652476	17.888
17.464249	17.888

16.763054	17.888
16.911535	17.888
15.779734	17.888
16.673332	17.888
17.14643	17.888
15.905973	17.888
15.996685	17.888
15.066519	17.888
17.262676	17.888
17.776388	17.888
16.852299	17.888
15.556349	17.888
17.406895	17.888
15.491934	17.888
16.492422	17.888
17.720045	17.888
15.264338	17.888
17.175564	17.888
17.521416	17.888
15.459625	17.888
17.58722	17.888
15.6205	17.888
15.9687195	17.888
16.822603	17.888
15.874508	17.888
17.117243	17.888
17.888544	17.888

Table 5.3 Comparison of Power for RASA and PSO

This table shows the comparisons for power consumption for both RASA and PSO.

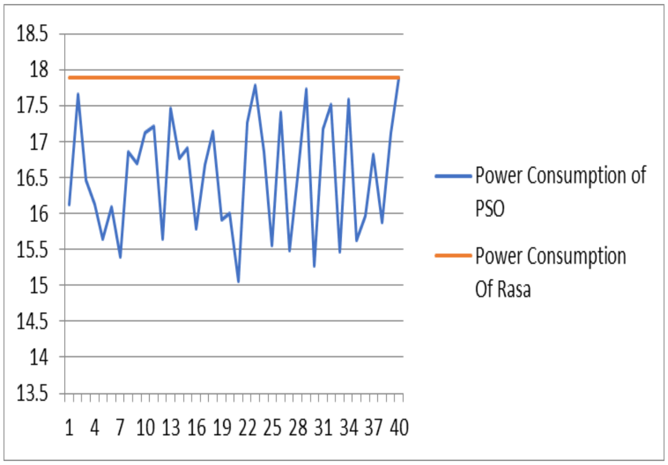
5.4 Comparison of average for power for RASA and PSO

Average Power consumption PSO(J)	Average power consumption RASA(J)
16.54030369	17.888

Table 5.4 average for power for RASA and PSO

This table shows the average power consumption for both PSO and RASA.

5.5 Comparison Graph for Power of RASA and PSO



Graph 5.5 Comparison Graph for Power of RASA and PSO

This graph shows the comparison for power consumption of PSO and RASA. Clearly it is depicted PSO is more efficient compared to the RASA. Such that less energy is required to schedule the resources for the process for the efficiency of the process. it is the total power consumed while executing the task from a gibe resource. In case of PSO the power consumption is less compare to the RASA. That means in context to the power the PSO performance has improved to 16.53%.

5.6 Comparison of Throughput for PSO and RASA

Throughput of PSO(per second)	Throughput of RASA(per second)
17.84555749	13.88854356
18.11643349	**17.88854356**
19.43861511	13.88854356
18.84555749	13.88854356
19.44404947	16.88854356
18.88383213	13.88854356
20.78623411	15.88854356
16.98850744	16.88854356
17.15789916	15.88854356
18.69459956	15.88854356
17.59962183	14.88854356
19.44404946	16.88854356

17.32314726	13.88854356
18.08960038	15.88854356
17.92199584	14.88854356
20.27917624	15.88854356
19.19232435	13.88854356
18.66277805	13.88854356
18.11822799	17.88854356
20.1925182	13.88854356
20.23914652	17.88854356
17.53710257	17.88854356
16.00140709	14.88854356
18.98850744	14.88854356
20.5703796	14.88854356
18.3835202	13.88854356
18.6559106	16.88854356
18.40285047	17.88854356
18.05864479	17.88854356
18.963897	13.88854356
18.63112055	17.88854356
17.2633644	13.88854356
19.69907872	14.88854356
17.75873283	17.88854356
18.48590045	13.88854356
19.0391772	15.88854356
18.02202624	13.88854356
19.15810517	13.88854356
18.69459956	13.88854356
17.88854355	16.88854356

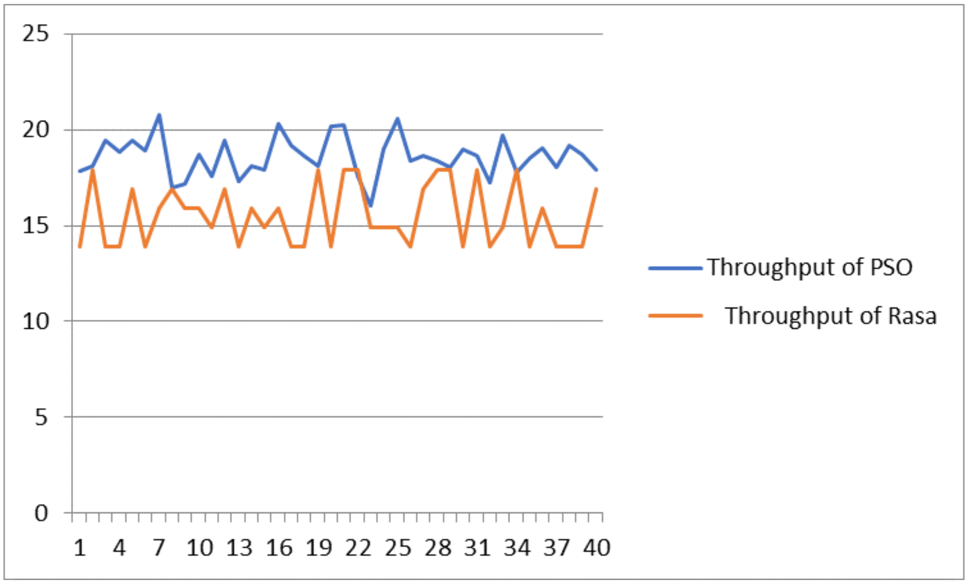
Table 5.6 Throughput for PSO and RASA

This table shows the comparison for throughput under both RASA and PSO.

Average Throughput for PSO	Average Throughput for RASA
18.5866685	**15.51354356**

Table 5.7 Average Throughput for RASA and PSO

This table shows the comparison for Average Throughput for both RASA and PSO



Graph 5.8 Comparison Graph for Throughput of RASA and PSO

This graph depicts the throughput comparison for PSO and RASA. Throughput has improved over to the RASA. It is the performance parameter in terms to number of processes per unit interval of time. In case of PSO the throughput has improved to 8.11%.

VI. CONCLUSION AND FUTURE SCOPE

From the current research it is clear that cloud efficiency will depends upon this issue that how well cloud schedules the resources amongst different processes. MAX-MIN and MIN-MIN individually are not so efficient because there may be various longer or even shorter tasks. For optimization of the selection process in current research we have used PSO. This technique identifies the best possible resources amongst the multiple available resources. In previous research the RASA based technique was used. Performance parameters like throughput, power consumption has been used to compare the performance of previous and current research. PSO has improved upon the power consumption and throughput. Power consumption has improved 16.53%. and throughput has improved upon 8.11%.

VII. FUTURE SCOPE

In future another genetic based approach can be tested and compared with PSO. So that best optimization technique can be identified.

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