Journal of King Saud University – Computer and Information Sciences (2016) **28**, 55–67

King Saud University

**Journal of King Saud University – Computer and Information Sciences**

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# A novel algorithm for reducing energy-consumption in cloud computing environment: Web service computing approach

**N. Moganarangan** [a], **R.G. Babukarthik** [b,*], **S. Bhuvaneswari** [b], **M.S. Saleem Basha** [b], **P. Dhavachelvan** [b]

[a] *Department of Computer Science and Engineering, Manonmaniam Sundaranar University, Tamil Nadu, India*
[b] *Department of Computer Science, Pondicherry University, Puducherry, India*

Received 11 October 2013; revised 8 March 2014; accepted 3 April 2014
Available online 17 November 2015

**KEYWORDS**

ACO ant colony optimization;
CS cuckoo search;
VSF voltage scaling factor;
EcPSO extended compact particle swarm optimization

**Abstract** Cloud computing slowly gained an important role in scientific application, on-demand facility of virtualized resources is provided as a service with the help of virtualization without any additional waiting time. Energy consumption is reduced for job scheduling problems based on makespan constraint which in turn leads to significant decrease in the energy cost. Additionally, there is an increase in complexity for scheduling problems mainly because the application is not based on makespan constraint. In this paper we propose a new Hybrid algorithm combining the benefits of ACO and cuckoo search algorithm. It is focused on the voltage scaling factor for reduction of energy consumption. Performance of the Hybrid algorithm is considerably increased from 45 tasks onward when compared to ACO. Energy consumed by Hybrid algorithm is measured and energy improvement is evaluated up to 35 tasks. Energy consumption is the same as ACO algorithm because as the number of tasks increases (45 to 70) there is a considerable decrease in the energy consumption rate. Makespan of Hybrid algorithm based on number of tasks is compared with ACO algorithm. Further we have analyzed the energy consumption for a number of processors and its improvement rate – up to 6 processors, energy consumption is considerably reduced and the energy consumption tends to be in steady state with further increase in the number of processors.


* Corresponding author.
E-mail addresses: rengannsj77@gmail.com (N. Moganarangan), r.g.babukarthik@gmail.com (R.G. Babukarthik), booni_67@yahoo.co.in (S. Bhuvaneswari), m.s.saleembasha@gmail.com (M.S. Saleem Basha), dhavachelvan@gmail.com (P. Dhavachelvan).
Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.jksuci.2014.04.007

## 1. Introduction

Cloud computing is becoming one of the predominant approaches in rendering IT services by reducing cost for the consumers. The approach not only influenced techniques used in computing but in turn processes, technology used for constructing and managing IT within the service provider and the enterprise. By offering a secure computing paradigm, cloud computing is becoming an important platform for scientific application. On-demand facility of virtualized resources as service is offered using virtualization in cloud computing without any delay (Venkatesan et al., 2013; Rajeswari et al., 2014).

Cloud computing technologies offer major benefits to the IT industries such as elasticity and rapid provisioning which includes increasing or decreasing the infrastructure facilities for a particular time based upon the required needs. Pay-as-you-go-model deals with the organization that requires any services and pay for the exact amount of resources they utilized in terms of infrastructure, platform and software as services. Capital cost is reduced as organizations do not need to have an inbuilt infrastructure, thereby resulting in the reduction of infrastructure. Access to unlimited resources in cloud computing means that the cloud provider has been able to deploy hundreds of server instances simultaneously; thereby it is possible to access unlimited resources. Flexibility means that deploying cloud instances by means of varying hardware configuration, various operating systems and different software packages (Dhavachelvan et al., 2006; Dhavachelvan and Uma, 2005). Some benefits of the cloud include *fault tolerance and high availability*. Since the cluster worker nodes are spread around the cloud sites, in the event of cloud down time or failure, cluster operations will not be interrupted at any cost of time as the worker nodes will take care of it. *Infrastructure cost reduction*: the pricing models among the cloud providers may vary considerably; the cluster node will change the location from one provider to another one thus reducing the overall infrastructure cost.

The main reason behind focusing on energy efficiency is due to the increase in energy cost spent on data center. The server machine is the vital component for increase in electrical cost. The electrical cost of the server machine is due to direct power consumption and cooling equipment used in it. In the data center 75% of energy cost is due to direct power consumed by server machine and indirect power used for cooling equipment. Additionally, due to the use of high performance multi-core processors in server machine, there exists power hunger and dissipation of considerable heat.

The following work is contributed:

- Proposal of a new Hybrid algorithm using ACO and cuckoo search.
- Analysis of job creation time, task creation time, destruction time, result retrieval time and total time for Hybrid algorithm.
- Performance comparison of a new Hybrid algorithm and ACO algorithm.
- Makespan improvement comparison of a new Hybrid algorithm with ACO algorithm.
- Energy comparison of a new Hybrid algorithm and ACO algorithm.
- Studied energy and makespan based on the number of tasks for Hybrid algorithm.

The remainder of this paper is structured as follows: Section 2 deals with previous work that has been carried for scheduling job in cloud computing for minimization of energy, makespan and resources. In Section 3 we propose a new Hybrid algorithm for scheduling job using ACO and cuckoo search, Procedure for Hybrid algorithm and pictorial representation of Hybrid algorithm using flow charts. Section 4 describes the implementation details of Hybrid algorithm and its performance, energy, makespan which has been compared with ACO algorithm. Section 5 states the conclusion and direction for future research.

## 2. Related work

Parallel bi-objective genetic algorithm is based on Energy-conscious scheduling heuristic. It minimizes the energy consumption and the make span. The major drawback is that it consumes more resources (Mezmaz et al., 2011). Without detailed information of participating node or centralized node, Community-Aware Scheduling Algorithm (CASA) increases both average job waiting time and job slowdown radically (Huang et al., 2013). Elastic cluster architecture supports execution of heterogeneous application domain, which dynamically partitions cluster capacity and adapts to variable demands (Montero et al., 2011). Performance of cloud computing services is analyzed for scientific computing workloads based on loosely coupled applications (Iosup, 2011). Based on network-flow-theory is modeled an algorithm for data center to reduce energy and virtual machines migration thereby reducing the overhead of virtual machines (SiYuan, 2013). For achieving optimal growth in various cloud infrastructure mathematical models are proposed stating that the response time of the slowest nodes is not more than three times of fastest node (Yeo and Lee, 2011). The algorithms depict how to achieve predictability and feasibility (Duan et al., 2007). On the basis of the Berger model, job scheduling algorithm is proposed, generally user tasks is classified by the model based on resource fairness justice function and QoS preferences to judge fairness of resource allocation (Xu et al., 2011). Across various multiple data centers near-optimal scheduling policies are achieved by cloud provider based on factors of energy efficiency such as carbon emission rate, energy cost, CPU power efficiency, and workload, (Garg et al., 2011). In case of dynamic-urgent cloud environment a good support is provided by layered and historical queuing performance model. It provides guidelines for parameterizing the models at a lower overhead (Bacigalupo et al., 2011). The workload that measured hybrid configuration compared to local setup reveals performance-cost ratio from analyzing the cost of multi-cloud (Moreno-Vozmediano et al., 2011). Gross cost is reduced in life time of entire application in elastic cloud computing by determining optimal number of computing resources per charge unit using partitioned balanced time scheduling (Byun et al., 2011). Inter-arrival time, status, parallel runtime, user, request time and application are features of failed job (YulaiYuan, 2012). Traditional formulation of scheduling problem is covered by algorithm such as trust dynamic level scheduling, for enabling cloud environment execution time