Cuckoo Optimization Algorithm Based Job Scheduling Using Cloud and Fog Computing in Smart Grid

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Abstract

Abstract. The integration of Smart Grid (SG) with cloud and fog computing has improved the energy management system. The conversion of traditional grid system to SG with cloud environment results in enormous amount of data at the data centers. Rapid increase in the automated envi- ronment has increased the demand of cloud computing. Cloud comput- ing provides services at the low cost and with better efficiency. Although problems still exists in cloud computing such as Response Time (RT), Processing Time (PT) and resource management. More users are being attracted towards cloud computing which is resulting in more energy consumption. Fog computing is emerged as an extension of cloud computing and have added more services to the cloud computing like security, latency and load traffic minimization. In this paper a Cuckoo Optimization Algorithm (COA) based load balancing technique is proposed for better management of resources. The COA is used to assign suitable tasks to Virtual Machines (VMs). The algorithm detects under and over utilized VMs and switch off the under-utilized VMs. This process turn down many VMs which puts a big impact on energy consumption. The simulation is done in Cloud Sim environment, it shows that proposed technique has better response time at low cost than other existing load balancing algorithms like Round Robin (RR) and Throttled. Keywords: Cloud Computing · Fog Computing · Smart Grid Cuckoo Optimization Algorithm · Round Robin · Throttled

1 Introduction

The demand of electricity has increased enormously from last couple of decades. For example, surveys shows that electricity consumption, only in US has increased to 2.5tem fails to distribute the large amount of electricity to the users. In addition

traditional energy distribution system does not provides the facility to end users c Springer Nature Switzerland AG 2019 F. Xhafa et al. (Eds.): INCoS 2018, LNDECT 23, pp. 34–46, 2019. https://doi.org/10.1007/978-3-319-98557-2_4

COA Job Scheduling Using Cloud and Fog Computing 35

to control or monitor their energy requirements. Therefor the idea of SG sys- tem come into existence for better and efficient distribution of energy. SG has a

two way communication [1], it gives freedom to end users to manage their energy

consumption limits. Unlike traditional grid system where user do not have oppor- tunity to manage their energy needs. The idea in SG is to make a live connection

between the electricity provider and the users. In this way providers and users will know how much energy is required. To make this connection between the users and providers, integration of Cloud and Fog computing environment with SG is proposed. Cloud computing is the process of providing computing services to the users over the Internet, these services includes storage and databases, online servers, software and many more [2]. The users have to pay for these services to the cloud providers. Cloud computing is one hot topic these days, companies are moving their non-cloud based products to cloud computing. Cloud can be used to access a large amount of data more quickly, this is where the idea of fog computing come into existence. Since many companies are using cloud computing services now a days, this has increased the number of customers of cloud. So there is a lot of user's requests traffic at cloud, it becomes almost difficult for the cloud to cope up with user requirements. Fog or 'Fogging' is used for this purpose. Fog simply shifts the cloud services [3] to the edge of the network. Fog works as a middle layer between the cloud and users. Simply speaking fog have added more reliable services to the cloud. Fog provides much quicker services to the users than cloud. Moreover it has better security parameters than cloud which is a big issue in cloud computing. Talking about the integration of cloud and fog with SG, users make many requests at a time. These requests can be generated for electricity requirements or other services. Using cloud and fog with SG a network between the end users and the cloud system is made. User communicates with the fog and it proceeds these requests to the cloud [4]. In proposed case user makes requests for electricity to the fog and fog then response back with the required services. These services are provided by the nearest available source. In proposed scenario there are 3 different levels at the top level there exists a centralized cloud. In second level fogs are installed, each fog have multiple VMs installed in it. Energy consumption area is at the lowest level. There are group of buildings, these group of buildings are divided into different clusters. Each cluster is directly connected with fog in that region. Request are generated from these clusters of buildings to fogs. Data on the fog is stored temporarily, fog send it to the cloud for permanent storage. The basic purpose is to provide users with their required services in least amount of time, the time taken by the fog to response back to request is

called the Response Time (RT) [5]. This is possible only when there is balance between the user's requests and the fogs. Fog takes different amount of time to process a request, the time taken by a fog to process a request is called the Processing Time (PT). When a fog is over utilized it will take a lot of time to process the request, on the other hand an under-utilized fog will perform these operations in less time. In this research we have used COA for the optimization of over and underutilized fogs.

36 S. Nazir et al. The rest of the paper is organized as follows. In Sect. 2 motivation and related work is presented in Sect. 3. The proposed system model and COA is described in Sect. 4. Finally we discuss the simulation results and conclusion in Sects. 5 and 6. 2 Motivation A cloud-fog based model is presented in [1]. An integration of cloud and fog is done for the effective resource distribution in smart buildings. The purpose of this work is to provide services to the end users with minimum RT. Different load balancing algorithms like Throttled and RR are used for job scheduling in Micro Grids (MGs) [2]. In this research our focus is in the combination of cloud and fog for optimization problems. Cloud Computing is becoming an essential part of our lives. Many companies are using this technology now a days like Amazon, Google, and Microsoft. Companies are moving their non-cloud based application towards cloud computing [6]. The increase in number of cloud computing customers is causing more energy consumption and more user request traffic in cloud data centers. So it is essential to manage the energy system and requests coming from users [7]. In this paper COA is used for load balancing purpose. Multiple requests comes from users at a time, management of these requests is not an easy task. In this scenario there are fogs connected to the clouds and the VMs. User put a request to the fog via VM, sometimes some fogs are over-utilized means they are dealing with too many requests. The over-utilized fogs cannot satisfy the need of request allocated to it. Some fogs on the other hand are under-utilized. These fogs are not getting as many requests as over-utilized fogs but they are consuming the same amount of energy as the over-utilized fogs. So our goal is to first of all detect these over-utilized and under-utilized fogs. If possible migrate some of VMs from over-utilized fogs to other fogs and reduce their utilization, or move all the VMs of under-utilized fogs to over-utilized fogs and switch them into sleep mode. In our case all the hosts or fogs that are not under-utilized are considered as over-utilized. By switching the under-utilized fogs into the sleep mode and migrating all of their VMs to over-utilized fogs will give more opportunity to over-utilized fogs to deal better with the request being generated by the users. Putting some fogs into sleep mode will make a big impact on the consumption of electricity. 3 Related Work In [1], the authors proposed an integration of cloud and fog based environment for

effective resource distribution in residential areas. Different load balancing algo- rithms like RR, Throttled are used for with service broker policies for resource

allocation. A new service broker policy is introduced with the name of dynamic service proximity for the selection of most suitable fog to perform a task. Later

Algorithm	Objectives
Dynamic Service Proximity [1]	Load Balancing and Energy Management
Practical Swarm Optimization (PSO) VM Load Balancer [2]	Efficient Resource Utilization
Shortest Job First [3] PSO with Simulated Annealing (PSOSA) [4]	Resource Allocation Efficient Resource Allocation
PSO with Simulated Annealing (PSOSA) [4] height	Efficient Resource Allocation

Table 1: Caption