DEVELOPMENT OF A METAHEURISTIC-BASED LOAD BALANCING ALGORITHM TO MITIGATE OVERLOADING IN FEDERATED CLOUD INFRASTRUCTURES

AKINOLA, DAMOLA GIDEON
(21PCK02317)
B.Eng. Electrical Electronic Engineering, Federal University of Technology Akure, Ondo State

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B.Eng. Electrical Electronic Engineering, Federal University of Technology Akure, Ondo State

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ENGINEERING (M.Eng) DEGREE IN INFORMATION AND COMMUNICATION ENGINEERING, IN THE DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY, OTA, OGUN STATE, NIGERIA

JULY 2023

ACCEPTANCE

This is to attest that this dissertation has been accepted in partial fulfilment of the requirements for the award of the degree of Master of Engineering in Information and Communication Engineering in the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Nigeria.

Miss Adefunke F. Oyinloye
(Secretary, School of Postgraduate Studies) **Signature and Date**

Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

DECLARATION

I, **AKINOLA, DAMOLA GIDEON (21PCK02317)**, declare that this dissertation is a representation of my work, and is written and implemented by me under the supervision of Prof. Emmanuel ADETIBA of the Department of Electrical and Information Engineering, Covenant University, Ota, Nigeria. I attest that this dissertation has in no way been submitted either wholly or partially to any other university or institution of higher learning for the award of a masters' degree. All information cited from published and unpublished literature has been duly referenced.

AKINOLA, DAMOLA GIDEON

Signature and Date

CERTIFICATION

This is to certify that the research work titled "**DEVELOPMENT OF A METAHEURISTIC-BASED LOAD BALANCING ALGORITHM TO MITIGATE OVERLOADING IN FEDERATED CLOUD INFRASTRUCTURES**", an original research work carried out by **AKINOLA, DAMOLA GIDEON (21PCK02317**) meets the requirements and regulations governing the award of Master of Engineering (M.Eng.) degree in Information and Communication Engineering from the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, and is approved for its contribution to knowledge and literary presentation.

07/08/2023

Prof. Emmanuel Adetiba
(Supervisor) **Signature and Date**

Dr. Isaac A. Samuel
(Head of Department) **Signature and Date**

Prof. Francis Ayansi
(External Examiner) **Signature and Date**

Prof. Akan B. Williams
(Dean, School of Postgraduate Studies) **Signature and Date**

DEDICATION

This research work is dedicated to the Almighty God, my late parents Mr. Samuel Tunde Akinola and Mrs. Christiana Olufemi Akinola, all orphans and my well-wishers.

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LIST OF ABBREVIATIONS

CSPs Cloud Service Providers

SaaS Software as a Service

PaaS Platform as a Service

IaaS Infrastructure as a Service

SMEs Small and Medium Enterprises

QoS Quality of Service

CPU Computer Processing Unit

SLA Service Level Agreement

DC Data Center

FEDGEN Federated Genomics

CApIC-ACE Covenant Applied Informatics and Communication Africa Centre of Excellence

LBaaS Load balancer as a Service

VM Virtual Machine

RR Round-Robin

OLB Opportunistic Load Balancing

ESCE Equal Spread Current Execution

ACO Ant Colony Optimization

PSO Particle Swarm Optimization

CMP Cloud Management Platform

DNS Domain Name System

ABSTRACT

In a subscription-based service known as cloud computing, clients have scheduled access to shared resources such as data, software, and other assets as needed. Despite, several benefits, cloud computing, still faces significant difficulties. Load balancing which is the capacity of the cloud infrastructure to equally distribute tasks resources in the cloud environment has significant issues. A new idea of cloud deployment referred to as cloud federation was started in order to offer solutions to the issue of load unbalancing in the cloud infrastructures. However, in a federated cloud system, transparent workload sharing among participating Cloud Service Providers (CSP) is challenging. This research work presents the development of a load balancing algorithm in a simulated federated cloud environment by considering inter-cloud and intra-cloud loads. The inter-cloud load balancing was realized using Ant Colony Optimization (ACO) algorithm as the Federated Cloud Load Balancer (FedCloudBalancer) while the intra-cloud aspect was realized with an existing throttled load balancing algorithm. The implementation of the FedCloudBalancer and simulation of a federated cloud platform were carried out on CloudAnalyst Simulation toolkit. Experimental evaluations were carried out to check the effect of inter-cloud load balancer on the overall response time of the system and the overall processing time of the federated cloud environment. The results shows that the FedCloudBalancer with ACO performs well with an average response time of 92.33 ms as compared with 328.4 ms and 176.55 ms for Closest Datacenter (CDC) and Optimize Response Time (ORT) respectively. The FedCloudBalancer algorithm provides an improvement over the existing CDC and ORT inter-cloud load balancing algorithms using metaheuristic optimization approach.

Keywords: ACO, Balancing, CSPs, Cloud, Federated, Load, Throttled.