# An Adaptive Resource Management Framework for Cloud Computing Environment

## SUMMARY OF THESIS

Submitted to
Babasaheb Bhimrao Ambedkar University
(A Central University)
Lucknow

For the Award of the degree of

**Doctor of Philosophy**

In

COMPUTER SCIENCE

By


**SURENDRA KUMAR**

Under the Supervision of

**DR. NARANDER KUMAR**

DEPARTMENT OF COMPUTER SCIENCE
BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
(A CENTRAL UNIVERSITY)
LUCKNOW – 226025, UTTAR PRADESH, INDIA



FEBRUARY-2021

# Summary

# SUMMARY

Cloud computing is a utility-based computing paradigm. It provides a seamless acquisition of computing, storage and network resources to users on a payment basis, in a similar fashion like that of water, gas and electricity. Cloud computing is highly embraced by individuals and business organizations due to the advantages it offers, few of them be like-

- Zero or no opening investment for accessing computing resources like computing, memory and/or network as these are measured in metrical units and provided to cloud users on a demand basis.
- Cloud resources or services are available round the clock with negligible down-time and can be accessed from any location.
- Cloud users privacy and security features are well-maintained. Moreover, cloud functioning is transparent to its users.
- Cloud users are charged according to their utilization of cloud resources, thereby, extending the advantage of scalability.
- Cloud services are made available on a payment basis and are categorized as software, platform or infrastructure services.

Cloud computing still lies in its infancy stage. Its potential is yet to be unleashed in new business capabilities and advancements. However, like any other advancing technology, cloud also suffers from certain issues and trials which must addressed in time to make cloud adoption a seamless process for all.

The key mechanism behind cloud computing is virtualization which creates an abstraction of actual cloud resources, so that more and more number of users can utilize the potential of this technology. These abstracted resources are enveloped in virtual machines with same functions and interfaces as that of real/actual resources. An important aspect of virtualization is that it is transparent to the cloud user. These virtual resources are offered in different sizes, performance and cost. The entire life cycle of a virtual machine is controlled a virtual machine monitor (VMM) or a hypervisor software. A physical machine or server contains numerous virtual machines and is known as a host. Virtual machines residing on a host are therefore termed as guests. Hypervisor acts as a bridge between the actual resources of a host and its multiple guests by giving a virtual operating environment to execute the guest VM tasks.

Resource management in a virtualized environment like that of cloud systems is a continuous and testing task which reflects the constant changing demand-supply graph of the virtual resources. The existing techniques for resource management are doing their jobs as per their intended purposes, but the wide-spread adoption of cloud and its dynamic user base requires certain stringent measures towards managing cloud's resources.

The chapter-wise summary of the research is given below in brief:

## CHAPTER I

## INTRODUCTION

This chapter provides an introduction to cloud computing technology and its importance as a new paradigm of computing. The evolution of cloud and its classified services are described in detail. It also highlights the important attributes of cloud computing, its strengths and its weak points. A number of widely accepted and most cited definitions of cloud computing are also given. Cloud computing is a special type of distributed computing in which any type of resource, physical or virtual, can be made available to the users, worldwide, by means of powerful technology called virtualization of resources. Virtualization is given due importance with discussion on its types and utilities. The issue of resource management techniques in cloud computing environment is discussed with an outline on the primary objectives of the research work.

## CHAPTER II

## REVIEW OF LITERARURE

This chapter gives details of the existing literature on cloud computing technology, available resource management techniques in cloud environment, for example Vm Placement and VM migration, Scaling, Energy Efficiency, QoS and Other SLA, Security issues in cloud. The rapid adoption of cloud computing is done by the society emphasis the need efficient and feasible resource management techniques for managing the cloud resources. An extensive study of related research papers on resource management techniques suggests that the objectives and implementation of resource management in cloud networks are very different from classical networks. For example, in classical networks resources are only physical while in cloud, resources are physical as well as virtual. Therefore, a different approach is required for cloud computing to manage resources effectively. Several reputed journals, e-books, etc. are consulted for understanding the new research problems.

# CHAPTER III

# FUZZY VM PLACEMENT AND VM MIGRATION

In this chapter, An assignment time is explained by fuzzy numbers. Here, the fuzzy assignment has been changed over into minimum allocating time utilizing variables with the help of Yager's approach after that we used fuzzy branch and bound method for optimization. We get the optimized data set from using the Branch and bound system for the minimum time to assign the resource. This can be used for all kind of assignment problems and get the optimal resource allocation in minimum optimizations result. The mechanism is of VMs allocation in the cloud as well as VMs migration of virtual machine. VMs migration incorporates exchange of a running virtual machine over physical hosts. There are numerous procedures which are utilized to limit the down time and aggregate migration time to give better execution. With the expansion in the prevalence of distributed computing frameworks, virtual machine migration crosswise over server farms and resources pools will be incredibly valuable to server farm executives. Virtual machine (VMs) relocation is an irreplaceable instrument for dynamic resources administration in present cloud servers.

The content of this chapter is published in-

1. Resource Management to Virtual Machine Using Branch and Bound Technique in Cloud Computing Environment. In Soft Computing: Theories and Applications SoCTA, pp. 365-373. Springer, Singapore, 2019.

2. Virtual Machine Placement Using Statistical Mechanism in Cloud Computing Environment. International Journal of Applied Evolutionary Computation (IJAEC) IGI global, Vol. 9(3) pp.23-31 (2018).

3. Analysis of VM Placement for Resource Management in Virtual Environment. BRIS Journal of advance Science and Technology, Vol. 5(3). PP. 427-438, (2018).

## CHAPTER IV

## SCALING APPROACH FOR LOAD BALANCING

In this chapter, the estimation depends on profiling on the physical server. For every assignment period amid the execution and gather the CPU time use. On the off chance that the use is higher than the part of the CPU time that a VM can get. We expect that, with an all-around planned VM relocation, the VM can drain the time cut apportioned to it and accomplish a productivity of 100% when the calculation is executed on the VM. Else, it doesn't have enough calculation to exhaust the time cut apportioned to the VM. Hence, in the period, the productivity is the proportion among use and part of CPU time designated to a VM. The assessed resources usage effectiveness is the normal proficiency amid the execution. In the our research work we take five datacenters, 50 CloudLets, 50 VMs, 2GB RAM, dual-core machine and simulation run over the cloudsim and get the simulation scaling results.

The content of this chapter is published in-

- A Novel Scale Approach For Load Balancing With Hardware And Software In Cloud And IoT Platform. Journal Of Theoretical And Applied Information Technology, Vol 97, No. 8, pp. 2370-2380, (2019).

# CHAPTER V

## MINIMIZE ENERGY CONSUMPTION THROUGH DYNAMIC CONSOLIDATION OF VM ALLOCATION AND VM MIGRATION

In this chapter, we proposed a mechanism and executed as the VmSelection and VmAllocation instrument in the Cloudsim simulator. The simulations are performed in a random manner and demonstrate the simulation data of the proposed calculations as for energy utilization, no. of VMs migrations and no. of host shutdowns. Outcomes are accomplished obtain big datacenters beside no. of hosts, VMs changing from 50 to 1000. For every situation, ideal outcomes are accomplished and give the most optimized outcomes in each unique circumstance. These data are actually as if the VM association approach with Cloudsim simulator tool depends on neighborhood reverting and least replacement time in Optimal Online Heuristic mechanism Anton Beloglazov et al. 2012 [171]. Our proposed methodology, to minimizing the consumption of the energy in the cloud computing environments, we have utilized a similar methodology yet with predictive algorithm to deal with accomplish quicker Host/VM assignment and consequently comparative power consumptions in least time/cost.

The content of this chapter is published in-

- Dynamic Consolidation of VM Allocation and VM Migration to Optimize Energy Consumption of Cloud Data Centers. International Journal of Engineering and Advanced Technology, Vol 8, No. 6, pp. 4932-4937, (2019).

# CHAPTER VI

## QOS-BASED RESOURCE MANAGEMENT MECHANISM AND SERVICE LEVEL AGREEMENT

In this chapter, Greedy crow search (GCS) has a maximum usage of data center that is for more VMs allocation as well as it has the maximum number of VMs assigning to them, they are reachable from different data centers. Generally, data centers are chosen for migrations for most astounding use. By making such developments, attempt to initial data centers that have maximum usage yet at the same time, have unutilized maximum resources. Traveling salesman problem crow search (TSPCS) is like Greedy Crow Search (GCS) of distinction lies in the association among the data centers, a total coordinated is utilized in GCS that infers to each data centers have an immediate association with each other DC. Results demonstrate that the SSA is quicker than both the old-style First Fit methodology, the GCS and TSPCS. SSA takes lesser time to execute than different calculations. Additionally, a near study demonstrates SSA takes less number of migrations than First-Fit, GCS and TSPCS. The algorithm SSA gives better results and improves the QoS in a cloud computing.

Once established a SLA can't be changed and when violated the service is consequently discard, without first permitting the cloud service provider and client the choice of renegotiation. The service provider takes care of a high penalty and loses notoriety, while the purchaser may have a request discard. We have presented a SLA renegotiation model and life cycle to deal with proactively handles such SLA violations. The analyzing model makes conceivable a better situation (guaranteeing congruity of cloud service and lessening SLA penalty costs). The dynamic procedures depend on a utility capacity for the supplier and planning data produced by the rescheduling alternative picked before renegotiation. The presented SLA renegotiation model produces to a critical advance to empower a change of the SLA boundaries over the span of services. Furthermore, by utilizing the methods presented, the trust level in the service providers can be kept up by as yet providing the services with no interruption from the client's perspective. In the extended works, incorporate finishing the situation where violation is examined during service providers and consolidating service cost count into the cloud environment.

The content of this chapter is published in-

1. A Salp Swarm Optimization for Dynamic Resource Management to Improve Quality-of-Service in Cloud Computing Environment. International Journal of Sensors, Wireless Communications and Control, 2020. (Accepted) (In Press)
2. Conceptual Service Level Agreement Mechanism to Minimize the SLA Violation with SLA Negotiation Process in Cloud Computing Environment. Baghdad Science Journal, 2020. (Accepted)

## CHAPTER VII

## KEY GENERATION USING TRIANGULAR CUBICAL APPROACH FOR ENCRYPTION AND DECRYPTION

In this chapter, Key generation algorithms are plays an important role in cryptography for this concern keys are needed to maintain various parameters such as the cycle of functions, key size, message size, numbers of cycles etc. The cryptography algorithm faces a brute force attack issue which is not considered as its complexity is very high than others. This process is produced very high complexities which provide more security features and increase the ciphertext efficiency. Integers numbers used in encryption keys for matrix i,j and keys lie between 212 bits as well as key-space is approximately $2^{192}$ or $10^{59}$ keys. The entropy of the random matrix results is very efficient in the encryption and decryption process by using the CalculateEnt() function in MatLab. The entropy of the final key matrix is 0.9512 which nearest to 1 not to zero. So this block size of 16 decimal numbers is 95.12% randomly.

The content of this chapter is published in-

- Key Generation Technique for Encryption and Decryption using Triangular Cubical Approach in Cloud Computing Environment. Blockchain for 6G-Enabled Network-based Applications: A Vision, Architectural Elements, and Future Directions, 2020. (Accepted)

## CHAPTER VIII

## CONCLUSIONS AND FUTURE PESRPECTIVES

This chapter is devoted to the conclusions of the presented research work and the future perspectives in the area of cloud resource management. Cloud computing systems have a long way to go. Future computing world will strive on virtual resources promising seamless and continuous services. Hence, the issue of cloud resources management must be addressed in a timely and priority fashion. In the present research work, several issues of cloud resource management have been identified and independent solutions to each issue have been proposed.

These are -

- VM Placement and VM Migration
- Scaling
- Energy Efficiency
- QoS and Other SLA
- Security

The solutions provided for each sub-problem are feasible, scalable and dynamic in nature and efficiently manage cloud resources as validated by the simulation results. As future perspectives, this work can be extended for newer DCN architectures and interoperable clouds which enable a cloud user with the flexibility of shifting his/her acquired resources between datacenters and no disruption in serviceability.