An Energy-Efficient Task Scheduling using BAT Algorithm for Cloud Computing

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Abstract

Cloud computing is new style of technology the demand of end user increase day by day it cases more energy consumption. Energy consumption directly connected with the utilization of resource. Better resource management reduce energy system in the network for that reason in this paper BAT algorithm implement for load balancing technique with different parameter it result compare with ABC algorithm. By implementing BAT algorithm in VM policy it reduces 3% of energy consumption in the network. This result can be achieved by implementing proper load balancing technique due to that it can reduce energy management system in cloud computing.

Keywords — Cloud computing, Energy Management System, Virtualmachine, loadbalancing, Energy Consumption
I. Introduction

The new technology cloud computing has significantly changed over the last decade. The deliveries of virtualized IT resource over the internet are performed with the help of it. These services are delivered with the rule of pay and gain on demand with real time service [I]. Cloud resources are providing as universal tools and any user can rent and release these services with the help of internet. It becomes 21st century technology due to combination of high bandwidth communication and low cost computing with storage [II]. Cloud computing is the next generation of computing that reduces the complicity and improve the performance of the entire system [III]. Now a day’s people adopting new technology that is known as cloud computing in order to achieve their goal. The main advantage of this technology is fast speed large storage, and on demand access [IV]. It is the collection of virtualization and interconnected system parallel and distributed system, and share the system on the base of service level [V]. Energy management system in cloud computing is important issue for that reason many approach are used in data centre but the researcher used System with sensor management function and implement it in VM allocation system and reduce 3% energy system for cloud computing [VI]. Energy consumption and carbon emission are main issues in global world. Different companies try to reduce IT energy consumption by using different system like they using global data center. These data centre are green technology base and as well as energy efficient system is used [VII]. Figure 1 shows the different type of cloud computing and it working.

![Fig 1: Type of cloud computing](image)

Normally four types of cloud computing which are private, hybrids, public and community cloud. Different organization used according to their demand and requirement [VIII]. Cloud divided in to four layers which have different service like,

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hardware, infrastructure, software platform and application layer. These help for resources management, for end user to get their requirement application [IX] Figure 2 show the structure of cloud computing.

![Cloud Computing Structure](image)

**Fig 2: Structure of cloud computing**

Cloud computing consists of different service like, communication, integrating, management, platform and network service, and different organization uses these services in different field according to their demand[X]. It is growing rapidly and used every field of area like education, geospatial sciences, technologies, manufacturing, engineering, data intensive applications, health, life science, application programming services, different scientific, and business domains [XI]. Main advantage of cloud computing are cost reduction, data security, scalability, mobility, disaster recovery, control and competitive edge due to these future it become more reliable technology now a days [XII]. Last few years cloud computing has been grown very fast and many people and organization are moving toward placing their services on the cloud. According to the survey of international data corporation main issue in cloud computing are, limited control, security, downtime, load balancing and Energy Management [XIII]. This paper focuses on energy management in cloud computing.

II. **Energy Management systems**

Energy management is one of the main issues in cloud computing figure 3 show the three main type of energy management system static energy management system, dynamic energy management system, location choice and infrastructure change.

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These are the main category of energy management system which are future divided into eight groups but this study research focus on the dynamic energy Management system which have two sub parts which are hardware and software. We reduce dynamic energy management system in cloud computing with the help of proper load balancing in virtual machine.

Figure 4 shows the main type of energy management technique which are Predicative, Reactive and hybrid in this paper focus on reactive rule which will be apply in VM. Figure 5 shows the basic three type of energy consumption technique which are sleeping model, overloaded and unloaded these all condition can change with the help of...
proper load balancing. For that reason we implement BAT algorithm to reduce energy consumption.

Fig 5: Energy consumption in various modes

These are dynamic energy management system it can be improve with the help of proper load balancing system. Because the system cannot become sleeping mode, un loaded and over loaded. Figure 6 show the energy consumption of cloud computing.

Fig 6: show total energy used

Figure 6 shows the energy consumption from different year it show that the usage of increase every year and near future it increase up to 200% therefor need proper energy management system for cloud computing. It can be achieve with the help of proper load balancing some basic definition about it given below.

III. Load balancing

It is new flavor of computing which growing day by day with rich feature and service. It is also called as fifth generation of computing after mainframe, personal and client service. Now a day’s different service are available in distributed manner.

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Sometime the use of these services in feasible manner is big issue and sometime resources are become idle all these activities are known as cloud management [XIV]. There are many existing issue in cloud computing load balancing is one of them. Load balancing helps to distributed all load between all the viable node or VM. It relatively new technology and provide high resource utilization for better response time for different user demand. Normally there are two main type of load balancing which are static load balancing and dynamic load balancing in distributed environment [XV]. Static load balancing is the type of load balancing which depends on the current state and it implementation also effect the current state, it not change able during the running of the program. There are different types of static load balancing which can be implementing according to the requirement, one of the main disadvantages of this load balancing if one element falls then entire system down [XVI]. Dynamic load balancing Is the process which can be change able at any stage and any location and no need previous knowledge. The main advantage of dynamic load balancing is that if any node fail its does not affect the entire system. It just affects the performance of network, different type of dynamic load balancing which can use according to their demand [XVII]. Figure 7 shows the different data movement in cloud computing and user demand. Green signal show the energy management system in cloud computing.

\[\text{Fig 7: Show energy management system}\]

IV. Methodology

Cloud data center consist of physical and virtual infrastructure resources that consist of server and network system and different resources. Different user demands can access with the help of these data center in accurate and fast time. It contains large amount of data and information which work certain rule and regulation along with
different element [XVIII]. Figure 8 shows the data center of cloud computing with different element and rule.

Figure 8 shows the basic information about cloud data center VM policy mention in this study going to change in that policy by applying BAT and ABC algorithm for Energy Management system. Normally VM have two main phases which are mention in figure 9.

Figure 9 shows the inter structure of VM. It consists of two main parts which are VM development phase and VM management system. First phase consist of VM
creation, VM configuration, VM startup and application development. In second phase VM management which consist of VM life cycle, VM scheduling, application process in VM, VM migration and Physical management. Second phase can be change during the request demand or according the requirement. In this paper, we focus on VM scheduling for this purpose we used BAT algorithm for the reducing energy system. Figure 10 shows the rule.

Figure 10 show the load balancing rule in this study we focus on transfer strategies which are sub divided in two elements.

V. Simulation setup

For simulation purpose cloudsim 3.0.3 used after obtain result present by using Microsoft Excel. Cloudsim was originally developed in Grid Laboratory with the help of university of Melbourne and it knows due to simulation toolkit and they allow modeling and simulation environment for the developer [XIX].

Table 1: show the Parameter list

| Type          | Parameter                  | Value       |
|---------------|----------------------------|-------------|
| Region        | From 0 to 4                | 5           |
| Data Centre   | Number of data center      | 5           |
|               | Number of host             | 30          |
|               | Type of Manager            | Time and space |
|               | Bandwidth                  | 1000        |

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Virtual machine | Total number of VM | $5 \times 4 = 20$ |
|----------------|------------------|-----------------|
|                | Number of processor per virtual machine | 4 |

| Task | Virtual machine memory | 512 |
|------|------------------------|-----|
|      | Bandwidth in bit | 1000 |
|      | VM image size | 1000 |
|      | Number of task | 100 |
|      | Length of task | 100 byte |
|      | Number of processor per requirement | 100 |

| Memory | Type of manager | Time and space |
|--------|-----------------|-----------------|
|        | Total memory | 204800Mb |
|        | Number of processor | 4 per VM |
|        | Total processor | 120 |
|        | Storage Memory | 100000Mb |
|        | Viable memory | 10000 |

Table 1 shows the parameters which are used for simulation. According to this table parameter has been established for network to checking Energy management system in cloud computing using ABC and BAT algorithm.

**Mathematical Modelling for the Scheme:**

Load of data center can be calculated as adding the load of each VM.

\[
\text{Load}_{DC} = \sum \text{load}
\]

The processing time of data can be calculated as

\[
\text{PT}_{DC} = \frac{\text{Load}_{DC}}{\text{Capacity}_{DC}}
\]

User request time can be

\[
\sum_{\text{VM}=1}^{\text{no of job}} \text{time } p
\]

It means the user request to VM

Memory required for requested data can be

\[
\sum_{\text{VM}=1}^{\text{no of job}} \text{RAM}_p
\]
Capacity of VM

Capacity of VM \( C_j \) = No. of processors in VM \( (np) \) * Millions of instructions per second of each processor in VM \( (nm) \) + Bandwidth of network ability of VM \( (nb) \).

\[ C_j = np \times nm + nb \]

\[ P_j = \sum_{i=1}^{n} P_{ij} \text{ Where } j = 1 \ldots m \]

Processing time of multiple VM

\[ P_j = \sum_{i=1}^{n} \sum_{j=1}^{m} P_{ij} \]

Processing time of single VM

\[ F_j = \sum_{i=1}^{n} P_{ij} \text{ Where } j=1, 2 \ldots m \]

Calculate load balance in BAT algorithm

If network bandwidth is constant then:

\[ S. D. = \sqrt{\frac{\sum f_{xj}^2}{n} - \bar{X}^2} \text{ where } \bar{X} = \frac{\sum f_{xj}}{n} \]

If network bandwidth is not constant then:

\[ S. D. = \sqrt{\frac{\sum x_{ij}^2}{n} - \bar{X}^2} \text{ where } \bar{X} = \frac{\sum x_{ij}}{n} \]

In the above equation shows the VM processing time and calculation step of different load in virtual machine. Standard deviation used in BAT algorithm for calculating the load balancing of different task before submitting to VM.

VI. Result and discussion

In this section discuss about the result which are get after simulation. The main case of this paper to measure energy consumption in cloud computing using BAT algorithm.
Figure 11: Simulation 50 task

Figure 11 shows the result of 50 tasks according to the result BAT algorithm working more accurate as compare ABC algorithm. The execution time of BAT algorithm is fast as ABC algorithm.

Fig 12: Simulation 100 task

In figure 12 shows the result of 100 tasks according to the result BAT algorithm working more accurate as compare ABC algorithm. The execution time of BAT algorithm is fast as ABC algorithm.
Table 2 result comparison

| NO. Of task | Algorithm | Task complete | Task Un complete | Makespan | Energy remain % |
|-------------|-----------|---------------|-----------------|----------|----------------|
| 50          | ABC       | 45            | 5               | 33 Second| 2%             |
| 50          | BAT       | 47            | 3               | 30 Second| 1%             |
| 100         | ABC       | 93            | 7               | 112 Second| 2%             |
| 100         | BAT       | 97            | 3               | 108 Second| 3%             |

Table 2 shows the result of simulation that mentions the total task, complete time, and energy consumption, then the remaining capacity. According to the result, the BAT algorithm is the most efficient compared to the ABC algorithm because it reduces 3% of energy consumption in cloud computing.

Figure 13 shows the result of different tasks used to check the energy management system in cloud computing. According to the result, the BAT algorithm is better in all aspects compared to the ABC algorithm.

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VII. Conclusion

Due to simplicity and flexibility BAT algorithm used for optimization purpose in different field. In this study it was used for improvement in load balancing purpose if we make more accuracy in load balancing technique then it reduces energy management system in data centre. For that purpose BAT algorithm selected and it result compare with ABC algorithm. BAT algorithm implement in VM policy to improvement in load balancing technique. For simulation purpose cloudsim was used with 50 and 100 number of task along with different configuration of the network. After the simulation the result shows that BAT algorithm working more accurate as ABC algorithm and it improve load balancing technique in cloud computing. Due to accuracy in load balancing purpose it reduce 3% energy of data centre. In upcoming study will focus on more optimization purpose and also try to implement in real time network.

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References

I. Almasi, S., &Pratx, G. (2019). Cloud computing for big data. Big Data in Radiation Oncology

II. Aldakheel, E. A. (2011). A cloud computing framework for computer science education (Doctoral dissertation, Bowling Green State University)

III. Beloglazov, A., Abawajy, J., & Buyya, R. (2012). Energy-aware resource allocation heuristics for efficient management of data centers for cloud computing. Future generation computer systems, 28(5), 755-768

IV. Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., &Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. Future Generation computer systems, 25(6), 599-616.

V. Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., &Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. Future Generation computer systems, 25(6), 599-616.
VI. Tso, F. P., White, D. R., Jouet, S., Singer, J., & Pezaros, D. P. (2013, July). The Glasgow raspberry pi cloud: A scale model for cloud computing infrastructures. In 2013 IEEE 33rd International Conference on Distributed Computing Systems Workshops (pp. 108-112). IEEE.

VII. Erker, S., Lichtenwoehrer, P., Zach, F., & Stoeglehner, G. (2019). Interdisciplinary decision support model for grid-bound heat supply systems in urban areas. Energy, Sustainability and Society, 9(1), 11.

VIII. Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., & Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. Future Generation computer systems, 25(6), 599-616.

IX. Eager, D. L., Lazowska, E. D., & Zabojian, J. (1986). Adaptive load sharing in homogeneous distributed systems. IEEE transactions on software engineering, (5), 662-675.

X. Ghomi, E. J., Rahmani, A. M., & Qader, N. N. (2017). Load-balancing algorithms in cloud computing: a survey. Journal of Network and Computer Applications, 88, 50-71.

XI. Gupta, P., Seetharaman, A., & Raj, J. R. (2013). The usage and adoption of cloud computing by small and medium businesses. International Journal of Information Management, 33(5), 861-874.

XII. Lawrence, W. J., & Chang, M. J. K. (2018). Cloud computing and Virtualization: the “Entrepreneur without Borders” Workbench for 21st century Enterprise development. GSTF Journal on Computing (JoC), 1(1).

XIII. Mushtaq, M. F., Akram, U., Khan, I., Khan, S. N., Shahzad, A., & Ullah, A. (2017). Cloud computing environment and security challenges: A review. International Journal of Advanced Computer Science and Application, 8(10), 183-195.

XIV. Mell, P., & Grance, T. (2011). The NIST definition of cloud computing.

XV. Ronchi, A. M. (2019). Interaction Design Essentials. In e-Citizens (pp. 125-156). Springer, Cham.

XVI. Ullah, A., Nawi, N. M., Shahzad, A., Khan, S. N., & Aamir, M. (2017). An E-learning System in Malaysia based on Green Computing and Energy Level. JOIV: International Journal on Informatics Visualization, 1(4-2), 184-187.

XVII. Umar, S., & Baseer, S. (2016, August). Perception of cloud computing in universities of Peshawar, Pakistan. In 2016 Sixth International Conference on Innovative Computing Technology (INTECH) (pp. 87-91). IEEE.
XVIII. Subashini, S., & Kavitha, V. (2011A). A survey on security issues in service delivery models of cloud computing. Journal of network and computer applications, 34(1), 1-11.

XIX. Subashini, S., & Kavitha, V. (2011B). A survey on security issues in service delivery models of cloud computing. Journal of network and computer applications, 34(1), 1-11.