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Load balancing method to reduce the operating temperature for the reliability of the server

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1 Introduction

In recent years , computing services , such as grid computing and cloud computing , have attracted attention . One of the features of the computing services is that the CPU utilization of servers in the computing services frequently becomes 100% . However , the reliability of the servers decreases because it relates to temperature and the CPU utilization .

Many studies reduce power consumption by decreasing the number of running servers . However , the CPU utilization continue to operate at 100% . It does not take into account the reduction of reliability . It does not calculate the failure time of the server .

In this thesis , a method is proposed to improves the reliability of servers . As the number of running servers increase , the operating temperature become lower . On the other hand , the power consumption of servers increase . Therefore , the proposed method aggregates virtual machines into the servers to reduce power consumption while satisfying the reliability required by user . Because the proposed method is aimed at application to the cloud computing , the load of the proposed method is a per-virtual machine . In other words , this thesis solves the optimal placement problem of virtual machine . If the maintenance of the servers is difficult or the

cloud computing provider focuses on the continuation of the service , the proposed method is effective .

2 Proposed method

This thesis introduces a Low Operating Temperature (LOT) load balancing method to improve the reliability of servers . The LOT load balancing method aggregates virtual machines into the servers to reduce power consumption , which relates to the reliability . The policy of the aggregate is that the operating temperature does not exceed the threshold .

System model consists of multiple server groups and a network management server . The network management server is connected to the multiple server groups . The network management server manages virtual machine placement and monitors the temperature of the server in the multiple server groups . The network management server explores a deployable server for a virtual machine .

The LOT load balancing method assigns a virtual machine a server in the multiple server groups when CPU utilization and operating temperature of the server do not exceed 100% and the threshold , respectively .

3 Evalution

This research focuses on aluminum electrolytic capacitors . Because the aluminum electrolytic capacitors are vulnerable to heat , the life of the aluminum electrolytic capacitors is shorter than that of other equipment . According to calculation with aluminum electrolytic capacitors life prediction calculation tool , failure time of 0.01% reduces with the increase in surface temperature and ambient temperature . Based on a graph generated from the calculation with the prediction calculation tool , the constraint condition of the operating temperature is determined .

I evaluated the LOT load balancing method by comparing with a simplified Yajima method . The simplified Yajima method integrates virtual machines into the server without considering the reliability . the simplified Yajima method assigns a virtual machine to a server in the multiple server

groups when CPU utilization of the server do not exceed 100% . The operating temperature model which is created based on the actual measurement data and estimation program are created for the evaluation . I created operating temperature model based on the actual measurement data . The operating temperature model is different depending on the equipment .

In the estimation model , there is one server rack (1U \times 40) . The maximum number of running servers . The virtual machine request are known in advance . In the estimation , it does not take into account the memory and the network bandwidth and image size . The no running servers shifts to the standby mode .

Firstly the LOT load balancing method assumes , the failure time of 0.01 % assumes set as 10000h . Then the exhaust temperature threshold is 45.0

from the graph of the failure time of 0.01% and the operating temperature . After that , estimation program is executed . From the estimation results , the number of running servers and the highest exhaust temperature are 30 units and 44.8 , respectively . Final result is that the failure time of 0.01% is 10368h from 44.8 which is maximum exhaust temperature . On the other hand , results of the simplified Yajima method is that the number of servers running is 27 unit , the highest exhaust temperature is 46.0 . The failure time of 0.01% is 9026h .

In summary of the LOT load balancing method , although the number of running servers increases , but the operating temperature become lower . Therefore , failure time of 0.01 % increases . The LOT load balancing method satisfies the reliability required by the user .

After that , I evaluated the performance of the LOT load balancing method is evaluated with CloudSim . Here , this simulation generates multiple virtual machines . memory and bandwidth and image size are different . This simulation assigns virtual machines to servers with the LOT load balancing method and the simplified Yajima method .

From the results , The LOT load balancing method satisfy the reliability required by the user under all conditions . However , if there is a constraint strong physical resource shortage in addition to the operating temperature threshold , the number of virtual machines in a server decreases . In this case , LOT load balancing method is invalid . In order to effectively use LOT load balancing method , it is necessary to ensure sufficient physical

resources .

4 Conclusion and future work

This thesis has introduced a method ,called Low Operating Temperature (LOT) load balancing method . The LOT load balancing method aggregates virtual machines into the servers improve the reliability of servers . The policy of the aggregate is that the operating temperature does not exceed the threshold . As the estimation results of the LOT load balancing method , the reliability of servers improved . because the operating temperature became low by increasing the number of running servers . The number of running servers increase , but the operating temperature is low . The reliability is improved . A cloud environment simulator CloudSim is used to evaluate the performance of the LOT load balancing method . From the results , this research clarified applied scope of LOT load balancing method . Also , the air conditioning power consumption and the failure time of equipment are calculated with CloudSim .

Since this thesis examined only aluminum electrolytic capacitor , it is necessary to also examine other electronic components . Because this research did not create the complex thermal model , it is necessary to create the fluid model . Further , it is necessary to simulate the dynamic virtual machine .