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ANALYTICAL STUDY ON VIRTUAL MACHINE CONSOLIDATION FOR RESOURCE MANAGEMENT IN CLOUD COMPUTING ENVIRONMENT

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ABSTRACT

VM migration technique has been explained in detail, with the number of VM migrations being reduced significantly. For the selection of the virtual machine, we utilized the MMT (Minimum Migration Time) criteria. In addition, our VMC ensures that the same VM is not picked on a regular basis. In addition, we have provided tests and findings obtained via the use of our VMC methodology.For our VMC method, we have made use of the virtual machine migration idea. The migration of virtual machines may be done using either a save and restore method or live migration. The save and restore method of migration is not recommended since it results in a larger amount of VM downtime when compared to live migration.

KEYWORDS: Minimum, Migration, Virtual, Machine, Downtime.

I. INTRODUCTION

Virtual machine consolidation (VMC) is a resource management strategy for cloud infrastructure that is designed to be efficient. Three major stages are required to complete the virtual machine migration (VMC) process: selecting the source physical machine (PM), selecting the target virtual machine (VM), and selecting the destination physical machine (PM). Several VM migration procedures are carried out between PMs during the VMC process.Virtual Machine Consolidation (VMC) is a strategy for managing resources in the cloud in an energy-efficient and dynamic fashion. Occasionally, the operating VMs may be dispersed among a number of PMs. It is possible that certain PMs may be under-loaded while other PMs would be over-loaded as a result of this type of virtual machine deployment.

VMC transfers (migrates) virtual machines from less-used physical machines to more-used physical machines, therefore consolidating VMs in a smaller number of physical machines. The state of additional PMs can either be converted to power conservation mode or these PMs can be used to service other clients as a result of this action. Another work to be completed during the VMC phase is the transfer of some VMs from

overburdened PMs. PM will be relieved of some of its workload as a result of the relocation of VMs from overloaded PM.

Server consolidation is a data Centre operation that occurs on a regular basis. The VMC procedure is comprised mostly of three phases:

- Selection of source PMs from which we can relocate VMs
- Selection of VMs to be moved from source PMs
- Selection of objective PMs on which chose VMs will be relocated.

One of the most challenging challenges in VMC is maintaining a balance among resource usage and quality of service (quality of service).

II. LITERATURE REVIEW

Mijuskovic et al (2011) Processing IoT applications straightforwardly in the cloud may not be the most productive answer for each IoT situation, particularly for time-touchy applications. A promising option is to utilize mist and edge computing, which address the issue of dealing with the enormous data transmission capacity required by end gadgets. These standards force to deal with a lot of created data near the data sources instead of in the cloud. One of the contemplations of cloud-based IoT conditions is resource management, which commonly spins around resource designation, responsibility balance, resource provisioning, task booking, and QoS to accomplish execution upgrades. In this paper, we audit resource management procedures that can be applied for cloud, haze, and edge computing. The objective of this survey is to give an assessment system of measurements for resource management algorithms focusing on the cloud/haze and edge conditions. To this end, we first location research difficulties on resource management methods in that area. Thus, we order ebb and flow research commitments to help in directing an assessment structure. One of the primary commitments is an outline and investigation of examination papers tending to resource management strategies. Finishing up, this survey features chances of utilizing resource management methods inside the cloud/haze/edge worldview. This training is still at early turn of events and hindrances should be survived.

Shaw, Rachael (2010) throughout the last number of years there has been high speed increase and far and wide reception of cloud based administrations by a wide range of businesses to work on the adaptability and dependability of their administrations while additionally lessening costs. The prominence of the cloud has summoned significant worry for the high energy utilization and fossil fuel byproducts clear in the activity of data focuses today. One of the vital reasons for high energy utilization is wasteful resource management. While much exertion as of late has been committed to accomplishing further developed energy productive resource management methodologies, execution vulnerability has likewise become a significant prevention for cloud resource management frameworks. Execution vulnerabilities present critical difficulties for arranging and provisioning Virtual Machine (VM) resource portion and planning for the cloud while having adverse consequences by and large in accomplishing more prominent energy efficiencies and worked

on Quality of Service (QoS). Not at all like conventional resource management methodologies that depend on heuristics this work had presents novel anticipating based methodologies for booking and dispensing the computational resources of public cloud foundation. We will probably expand and make headways after existing examination by applying and looking at the exhibition of cutting edge learning algorithms utilizing genuine data. We investigate how these high level methodologies can be consolidated to bring about savvy resource management frameworks with the ability to settle on further developed choices under vulnerability. Specifically, we propose and examine a few fascinating varieties and augmentations to issues, for example, work process booking, dynamic VM combination and furthermore VM movement. The outcomes acquired from this examination demonstrate the gigantic capability of embracing learning based techniques to upgrade resource use, further develop execution and by and large endeavor to arrive at new outskirts in energy effectiveness.

Harvinder Singh et al (2015) Cloud resource management is pivotal for proficient resource allotment and booking that needs for satisfying clients' assumptions. However, it is hard to foresee a fitting coordinating in a heterogeneous and dynamic cloud climate that prompts execution corruption and SLA infringement. Hence, resource management is a difficult assignment that might be compromised in light of the unseemly portion of the necessary resource. This paper presents a precise audit and insightful correlations of existing studies, research work exists on SLA, resource designation and resource planning for cloud computing. Further, conversation on open exploration issues, ebb and flow status and future examination headings in the field of cloud resource management.

Guang-Shun Li et al (2010) with the rise and advancement of the Internet of Vehicles (IoV), fast reaction time and ultralow delay are required. Cloud computing administrations are negative for diminishing deferral and reaction time. Versatile edge computing (MEC) is a promising answer for address this issue. In this paper, we joined MEC and IoV to propose a particular vehicle edge resource management system, which comprises of haze hubs (FNs), data administration specialists (DSAs), and vehicles. A powerful assistance region parceling algorithm is intended to adjust the heap of DSA and work on the nature of administration. A resource designation system dependent on the Stackelberg game model is proposed to break down the evaluating issue of FNs and the data resource technique of DSA with an appropriated emphasis algorithm. The recreation results show that the proposed structure can guarantee the distribution effectiveness of FN resources among the vehicles. The structure accomplishes the ideal technique of the members and subgame wonderful Nash balance.

MalikaBendechache (2017) As of late, there has been huge progression in resource management systems for cloud computing framework execution as far as cost, quality of service (QoS) and energy utilization. The rise of the Internet of Things has prompted the improvement of foundation that stretches out past incorporated data habitats from the cloud to the edge, the alleged cloud-to-thing continuum (C2T). This framework is described by outrageous heterogeneity, geographic circulation, and intricacy, where the key

exhibition pointers (KPIs) for the customary model of cloud computing may presently don't matter similarly. Existing resource management components may not be reasonable for such complex conditions and consequently require careful testing, approval and assessment before being considered for live framework execution. Additionally, recently limited resource management recommendations might be more significant and deserving of returning to. Recreation is a generally utilized procedure in the turn of events and assessment of resource management systems for cloud computing yet is a moderately beginning exploration region for new C2T computing standards, for example, mist and edge computing. We present a systematic writing investigation of C2T resource management research utilizing reenactment software instruments to help analysts in recognizing reasonable techniques, algorithms, and recreation approaches for future examination. We examinations 35 exploration articles from a complete assortment of 317 diary articles distributed from January 2009 to March 2019. We present our unmistakable and engineered investigation from an assortment of viewpoints including resource management, C2T layer, and recreation.

III. RESEARCH METHODOLOGY

For the selection of the virtual machine, we utilized the MMT (Minimum Migration Time) criteria. In addition, our VMC ensures that the same VM is not picked on a regular basis. The save and restore method of migration is not recommended since it results in a larger amount of VM downtime when compared to live migration. Live VM migration can be performed either before or after a copy has been made. We ran a short experiment to determine the impact of virtual machine migration on an application. In our experiment, we employed live VM migration based on pre-copying to get our results. We've noticed that the performance of the application suffers throughout the migrating process.

IV. VMC ONSOLIDATION EXPERIMENTS AND RESULTS

In this part, we've spoken about two different experiments. It is demonstrated in this first experiment that the effect of VM live migration on an application running on it in a real-time environment is significant. In a simulation environment, a second experiment is carried out utilizing a proposed migration threshold-based strategy, which is described before. The second experiment is carried out in order to test that our suggested VMC strategy reduces the number of VM migrations as well as the number of SLA breaches.

- **Experiment 1 – Effect of VM Live Migration on the Performance of Applications Running on it.**

This testing was performed out in order to determine the impact of VM migration on the apps that were executing on it. Performance of the Apache web server is investigated in this experiment under two different virtual machine conditions: the standard VM condition and the VM migration condition. In our experiment, we employed a live transfer of a virtual machine. SAN (Storage Area Network) storage devices are required for the live migration of virtual machines and must be accessible by both the source and destination hosts in order for the migration to be successful. The images of virtual machines are stored on a network-based shared

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storage system. NFS, iSCSI, and other storage area networks are further possibilities for SAN. Because the SAN was not available throughout our trial, we had to rely on an NFS (Network File Server) as a backup storage solution.

Both the source and destination hosts must be on the same subnet in order for the VM to have the same IP address both during and after the migration. The CPU architecture and hypervisor on both the source and destination computers must be the same. Three different machines were utilized in this experiment. Figure 1depicts the specifics of their hardware and software configurations. In this experiment, we looked at two different scenarios.

Case 1: Performance of the Apache web server while it is operating in a virtual machine (Normal condition -within source host).

Case 2: The performance of the Apache web server when it is operating in a virtual machine (During VM migration process)

Algorithm 8 Optimize DC Algorithm

Require: Set of Running Hosts- **HostList**, Set of Running VMs- **VMList**
Ensure: Prepare **MigrationMap** and perform VM migrations.

```
1: Find Overloaded hosts based on threshold
2: OverloadedHostList ← findOverloaded(HostList)
3: for h in OverloadedHostList do
4:     Select VM v for migration by MMT criteria
5:     if v.migrationCount < threshold then
6:         add v to MigrationMap
7:         MigrationMap.add(v)
8:         if checkOverloadAfterMigration(v) = true then
9:             go to line 4
10:        else
11:            go to line 3
12:        end if
13:    else
14:        Select another VM v for migration by MMT criteria
15:        go to line 4
16:    end if
17: end for
18: migrateVMs(MigrationMap)
19: UnderLoadedHostList ← findUnderloaded(HostList)
20: for h in UnderloadedHostList do
21:    for v in h do
22:        if v.migrationCount < threshold then
23:            add v to MigrationMap
24:            MigrationMap.add(v)
25:        end if
26:    end for
27: end for
28: migrateVMs(MigrationMap)
29: End
```

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With the apache benchmarking (ab) tool, we sent 15000 http web queries to a static page hosted on the Apache web server, which was running inside a VM with the IP address 192.168.21185 in both cases, and the results were compared. Detailed instructions on how to submit several concurrent queries to the web server are provided below.

□□–□15000 –□25 –□"□□□□h □□□□.□□□"h □□□:// 192.168.21.185/□□□□.h □□□

The -n option specifies the total number of requests, the -c option indicates the concurrency of requests, and the -g option provides the name of the log file. Lastly, the URL of the page to be accessed is provided as a parameter. The log file contains information about the specifics of HTTP requests and answers and is used to track out problems. This log file was passed to the gnuplottool, which was used to generate graphs (Figures 2 and 3).

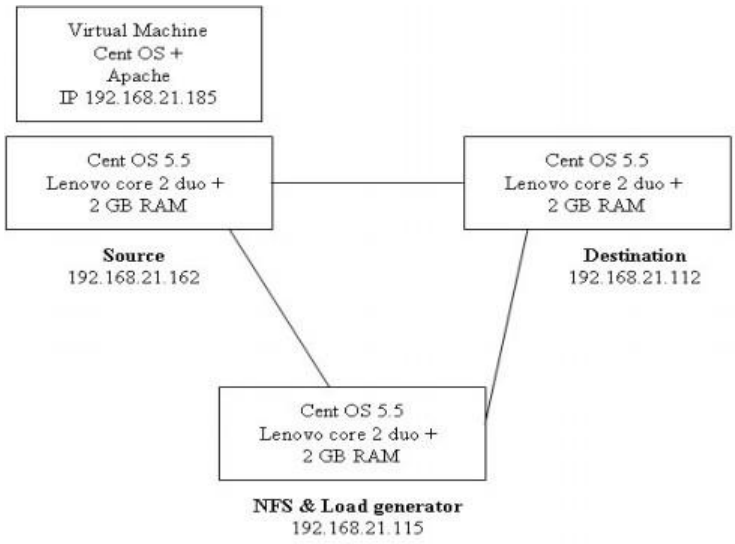

Figure 1 VM Live Migration Experiment Setup

The ab (Apache Benchmark) tool provides us with information about requests and the time it takes to fulfil each one (ms). Figure 2 and Figure 3 illustrate two graphs that we created using gnuplot based on the data that was obtained from the programme. During typical VM running (case 1), the time required to service each request (response time) is between 0 and 25 milliseconds, as seen by the graph in Figure 2.

Figure 3 depicts three distinct phases (case 2), which are as follows: Performance of the Apache web server prior to VM migration, during VM migration, and after VM migration has been completed are all measured. During the migration, we can see that performance is similar to scenario 1 both before and after the migration; however, during the migration, we can see that there is a greater delay in response time (up to 250 ms per request). One essential point to keep in mind is that live migration

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produces a slight increase in response time, but it is completely transparent to the user and the application in question. As a result of the transmission of its state information to the destination host, the VM becomes extremely active throughout the migration process. The same is true during migration, when a significant amount of network-related resources are used by the VM state transfer procedure. The response time of the Apache web server has risen as a result of this.

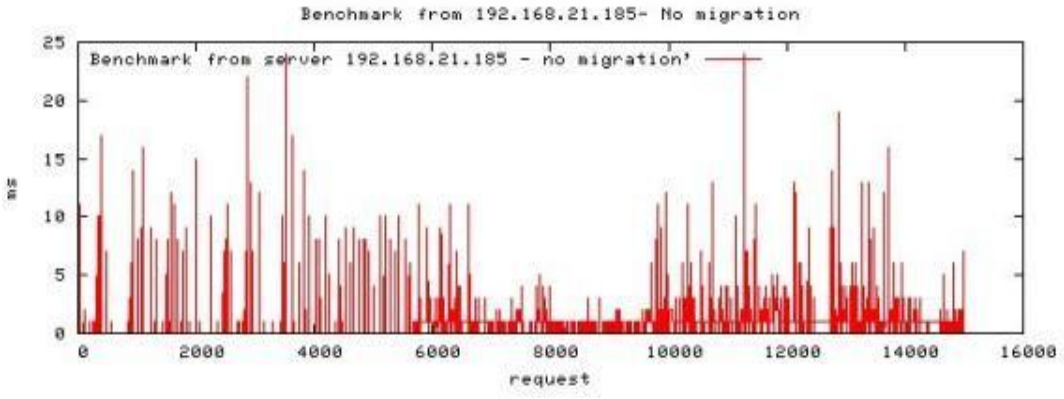

Figure 2 Performance of Apache Web server in Case 1

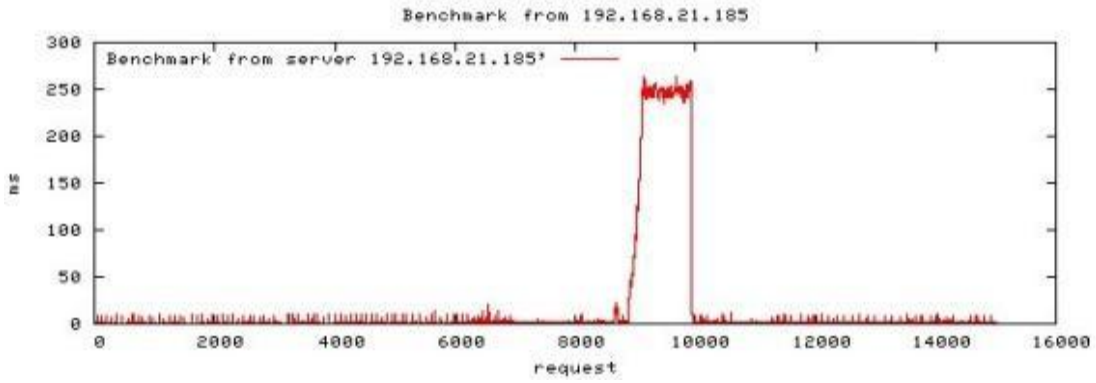

Figure 3 Performance of Apache Web server in Case 2

- **Experiment 2- Evaluate the Effects of Migration Count Threshold on VMC**

This experiment was carried out in order to determine the influence of the migration threshold on server consolidation and consolidation. We can plainly observe from the results of the experiment that the performance of apps running on VMs is decreased throughout the VM migration process. VMC is a recurring procedure that mostly consists of a large number of VM migration activities. The selection of the same virtual machine for migration on a regular basis will have a negative impact on the performance of apps operating on that VM. We

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have proposed a migration threshold-based consolidation approach in order to prevent this situation.

This experiment was carried out with the help of Cloudsim in order to determine the influence of the migration threshold on server consolidation. We have carried up experiments using MMT criterion for VM selection, both with and without taking individual migration count into account.

The Vm class, which is included in the org.cloudbus.cloudsim package, has had its code modified. It now has a counter variable as part of it. This variable is increased every time a virtual machine (VM) is moved. In addition, we have included a method in this class with the name getMigrationCount (). This technique is helpful for obtaining the value of the total number of migrations completed for a certain virtual machine. We've updated the Datacentre class provided in org.cloudbus.cloudsim to add the method for counting the number of virtual machines that have moved. The processVmMigrate() function has been changed such that, each time a virtual machine (VM) is migrated, the migration count number is increased by one.

org.cloudbus.cloudsim.power has a PowerVmAllocationPolicyMigrationAbstract class, which has been updated to work with PowerVmAllocationPolicyMigrationAbstract. This policy is implemented by changing the two procedures outlined in the next section:

[illegible]() &

[illegible]()

In this experiment, we took into account four different parameters: the energy consumption of the data center, the SLA performance deterioration of VMs, the number of VM migrations, and the SLA time per active host. Table 1 is a list of the experimental parameters.

Table 1 VMC Experiment Parameters

Parameter Name	Value
VM allocation Policy	Best Fit is decreasing
VM selection Policy	Minimum migration time
Overload threshold th	0.8 (80%)
Max migration per VM mig_th	0-10
Workload	Planetlab
Host Configuration	MIPS (1860,2660), PES=2 RAM 4096 MB

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VM Configuration	MIPS (500, 1000, 1200, 1500) PES=1, RAM 1024 MB
Number of Hosts and VMs	(20,50), (50,100), (100,2000) and (200,4000)

SLA time per Active Host - This metric displays the amount of time an active host is required to run with loads greater than the set threshold. The higher the value of this parameter, the longer the host is under stress, which has an adverse effect on the performance of virtual machines (VMs) operating on the host in question. This parameter's value should be as low as possible.

SLA performance degradation- This variable measures the impact of migration on the SLA of an application that is currently operating. According to the assumptions, during the migration, performance will be decreased by ten percent. The deterioration is exacerbated by frequent migration. It is preferable to have a smaller value for this parameter.

The total number of VM migrations conducted during the simulation is shown by the number of VM migrations executed in total. Based on the results of the preceding experiment, we can safely conclude that VM migration has a significant impact on overall performance. Better outcomes are obtained by selecting the right virtual machine for the transfer.

The amount of energy consumed by a data center is determined by the number of active hosts, the number of networking components, and the cooling method. The periodic consolidation procedure assists us in turning off computing equipment that are no longer needed.

Table 2 contains a summary of the simulation's findings. When compared to the default policy, we can see that our policy has a lower value of SLA time per active host. Observing our policy for different combinations of real and virtual machines once more, we can see that overall SLA breaches are less in our policy. In the instance of our policy, the overall number of VM migrations is smaller than before. When we look at the energy consumption numbers, we can observe that our VMC policy has a somewhat greater usage than the default VMC policy. However, the performance of our policy in terms of other parameters is superior to that of the default virtual machine policy (Table 2). The suggested policy reduces the likelihood of SLA violations since the number of VM migrations is limited by a migration count threshold, rather than a fixed number. In a similar vein, the aggregate total number of VM migrations is being decreased.

Table 2 VMC Experiment Results

Physical and Virtual	SLA time per Active Host (%)	Overall SLA Violation (%)	Energy Consumption	Number of VM migrations

Machines					(KwH)			
	Our Policy	Default	Our Policy	Default	Our Policy	Default	Our Policy	Default
20,50	1.78	4.59	0.02	0.04	1.73	0.79	98	102
40,100	1.96	4.48	0.02	0.03	3.19	1.47	198	199
100,200	1.16	5.50	0.03	0.03	6.28	3.04	422	462
150,400	2.65	6.59	0.04	0.06	12.67	7.01	869	1432

Based on the results of the tests mentioned in this part, we can infer that VM migration has an impact on the performance of the applications running on it.

The selection of the same virtual machine for migration on a regular basis during the consolidation phase has an adverse effect on the performance of applications operating on that VM. Increased speed is achieved by limiting the maximum number of migrations that may be performed by a single virtual machine (VM). Although the number of hosts that shut down operations is substantially reduced, the amount of electricity consumed increases as a result.

V. CONCLUSION

We've discovered that our reactive auto scaling strategies outperform the default reactive strategy in terms of overall performance. In a similar vein, our proactive scaling strategy, which is based on ARIMA, beats the default scaling policy.We have used an application on the VM in this context. For our application, we have created dumb workload. By using this experiment, we found that the time of application response changes proportionally, as the number of VM instances is increased or decreased. The experiment in a private cloud environment demonstrates that suggested methodologies can be implemented in genuine cloud contexts.

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