

VMFT: VIRTUAL MACHINE FAULT TOLERANCE IN CLOUD COMPUTING

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ABSTRACT: Cloud computing is the on demand based computing. It is used for storing, retrieving and processing the data with the help of internet connection at anywhere at any time. Today, many real time applications can be remotely processed on cloud environment. It provides many services such as resource pooling, wide range of network access, rapid elasticity etc. However, fault tolerance in cloud computing is the challenging problem nowadays and the detection and recovery of fault are the key issue. In order to reduce the impact of the fault, many fault tolerance techniques have been designed. In this paper, we have proposed the Virtual machine fault tolerance (VMFT). In this technique, the machine tolerates the fault based on the reliability of the virtual machine. It achieves high reliability, availability and reduces the service time. When the application is computed on the virtual machine, the VM which gives correct logical output within the time is considered as best VM among all the virtual machine and then that VM is taken for further processing of an application. With the help of a cloud sim tool the proposed VMFT technique is implemented.

KEYWORDS: Fault tolerance; Virtualisation; VM; Cloud computing; cloudsim tool; Reliability; Availability.

1 INTRODUCTION

Cloud computing plays a major role in the business and IT industry. Today, every one access the cloud with the help of internet connection at anywhere at any time. It offers many benefits such as storing, processing and retrieving the data remotely. It mainly provides three services such as SaaS, PaaS, IaaS. The Software as a Service (SAAS) provides services such that a single application runs on cloud infrastructure it provides multiple services to various kinds of end users [1]. The Platform as a service (PAAS) provides services such that the user can able to develop, deploy, debug and monitor the execution of the application by using resources with the proper software environment. The platform consists of both hardware and software infrastructure. The users develop and deploy the application with the help of software tools and programming languages provided by the cloud service provide [1]. The Infrastructure as a service (IAAS) provides services such as storage and computing capabilities. Various resources such as servers, storage system, Data centre space, Network equipment's are shared among many users to handle and balance the workload [1]. With the help of IAAS many users runs their application remotely on the cloud. When running their application, there may be a chance for fault. The fault may arise due to hardware failure, Virtual Machine failure, Network congestion, application or unavailability of resources. So there is an increased requirement for fault tolerance.

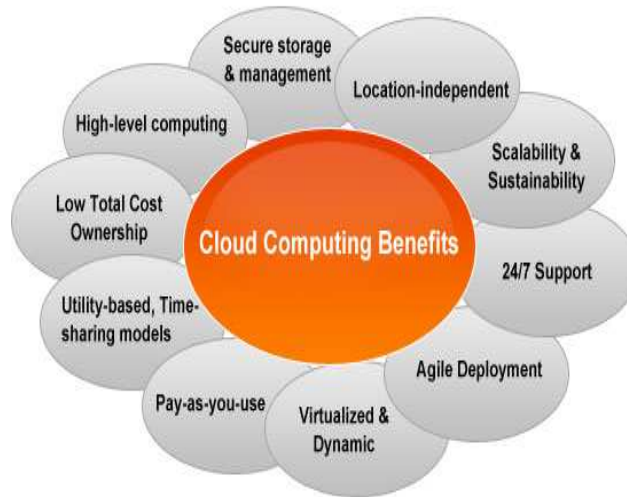


Fig. 1. Cloud computing benefits

2 RELATED WORK

Fault tolerance is essential in cloud computing to achieve reliability and availability, so that services can be delivered without any delay and wastage of resources and energy. It is the one in which the system continues to operate satisfactorily even in the presence of faults. It is the quick replacement and repairing of faulty nodes in case of failure [1][2]. There are many fault tolerance techniques available in cloud computing, but still this is under a research due to increased number of users and the need of “on demand services”. The main purpose of Fault tolerance techniques is to provide the robustness and dependability for cloud computing nodes [2]. Depending on the policies and procedures, the fault tolerance can be divided into two categories: [3]

- *Proactive Fault Tolerance*
- *Reactive Fault Tolerance*

2.1 PROACTIVE FAULT TOLERANCE

The proactive fault tolerance policy is used to predict the failure in advance and replace the failed components with other working components. It is to avoid the time taken to replace the failed components [4].

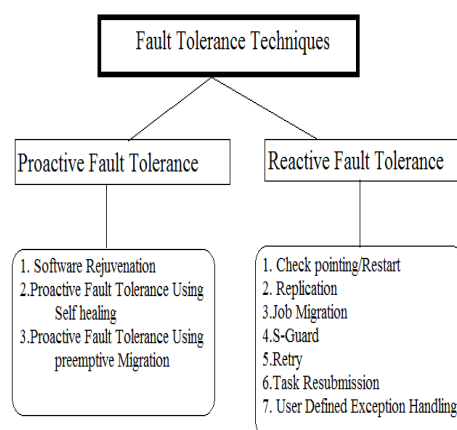


Fig.2.Types of Fault tolerance techniques

2.1.1 SOFTWARE REJUVENATION

It is the system which undergoes for periodic reboot. It restarts the system with clean state and started in fresh state [5].

2.1.2 PROACTIVE FAULT TOLERANCE USING SELF-HEALING

In this technique the divide and conquer method is applied for better performance. The large tasks are divided and distributed in to smaller subtask. Different instances of an application executes on different virtual machine, if a failure occurs when executing the application it automatically controls the failure [6].

2.1.3 PROACTIVE FAULT TOLERANCE USING PRE-EMPTIVE MIGRATION

The running applications are constantly monitored, observed and analysed by using a feedback loop control mechanism [5][6].

2.2 REACTIVE FAULT TOLERANCE

The Reactive Fault Tolerance policy is used to scale down the fault that are already occurred in the cloud environment .After the fault occurs, it takes the remedial measures. It is an on demand fault tolerance and makes the system more robust.[10]

2.2.1 CHECK POINTING /RESTART

It is done in task level for real time and large application. After making every change in the system a periodic check pointing is done [4].When a task execution fails, rather than started from the beginning it is restarted from the recently checked point [8].

2.2.2 REPLICATION

Replication means copying .The several replicas of the tasks are created and run on different resources for successful execution and to get the desired outcome. The tools such as HA-Proxy, Hadoop and AmazonEc2 are used for implementing the replication [4][7].

2.2.3 JOB MIGRATION

Due to certain reason a particular machine fails in the execution and cannot be executed further, in that situation a job is migrated to another working machine by using HA-Proxy

S-GUARD

It is based on roll back recovery. It is less turbulent to normal stream processing. It is implemented by using HADOOP, Amazon EC2.[10]

2.2.4 RETRY

The task is resubmitted again on the same cloud resources. It is the simplest task level technique.

2.2.5 TASK RESUBMISSION

Due to high network traffic and heavy work load a task may fail to execute, whenever a failed task is detected it is either resubmitted to the same or different cloud resources [7].

2.2.6 USER DEFINED EXCEPTION HANDLING

It is predefined by the user whenever the fault is detected [6].

2.2.7 RESCUE WORK FLOW

This technique allows the flow of application execution to persist until it will not be able to proceed without rectifying the fault [6][9].

2.2.8 TIMING CHECK

This technique a watch dog timer is used to check whether the application executes within the time or it exceeds the time. Depending up on the execution the further fault tolerance action takes place [10].

2.2.9 SAFETY – BAG CHECK

Blocking of commands takes place when the system does not met the safety properties [14].

3 PROPOSED MODEL (VMFT)

This scheme is proposed to handle the fault tolerance, particularly in the virtual machine. It is based on proactive fault tolerance. Today, many applications are stored on cloud for computing with the help of Virtual machine. If any fault occurs during execution of an application in the cloud the proposed VMFT technique takes the following action. The user does not know how to tolerate the fault and how the processing is done remotely on a cloud. This technique is mainly focused to provide high reliability and availability of resources in the cloud environment. The VMFT technique is mainly focused to tolerate the VM's fault based on its reliability. Depending up on the need of the user they send their request to the cloud service provider.

CLOUD SERVICE PROVIDER (CSP)

The cloud service provider provides services such as SAAS, IAAS and PAAS to the end user based on their demand. The IAAS provides services such as OS, Virtual disk space, Hardware, security, Virtual Data centre, Network components and storage. The provider sends the application to the physical machine. The physical machine sends the real time application to the hypervisor in order to speed up the execution of the user request.

HYPERVERSOR OR VIRTUAL MACHINE MONITOR (VMM)

With the help of Hypervisor or virtual machine monitor (VMM) a single physical machine can scale in to multiple virtual machine (VM).

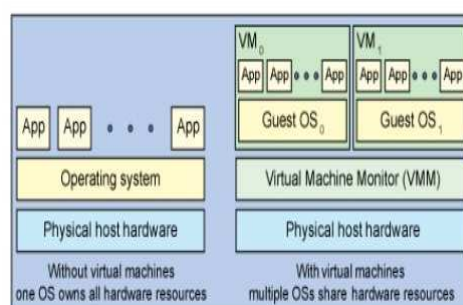


Fig. 3. Physical machine with VM and without VM

The above diagram shows that the machine with VM and without VM. The VM is the emulation of a physical machine. The Virtual machine is the one which have all the configuration as like the real physical machine such as OS ,Hardware, architecture, software, CPU, storage etc. Multiple Virtual machines can be created and they are isolated from each other to perform an application execution in a single physical host. It does all the functionality as host machine.

TIME MONITOR(TM)

The Time monitor monitors all the applications running in the guest OS (Virtual Machine). The VM is continuously observed and analysed. The VM which gives correct logical output on time is given to the reliability assessor.

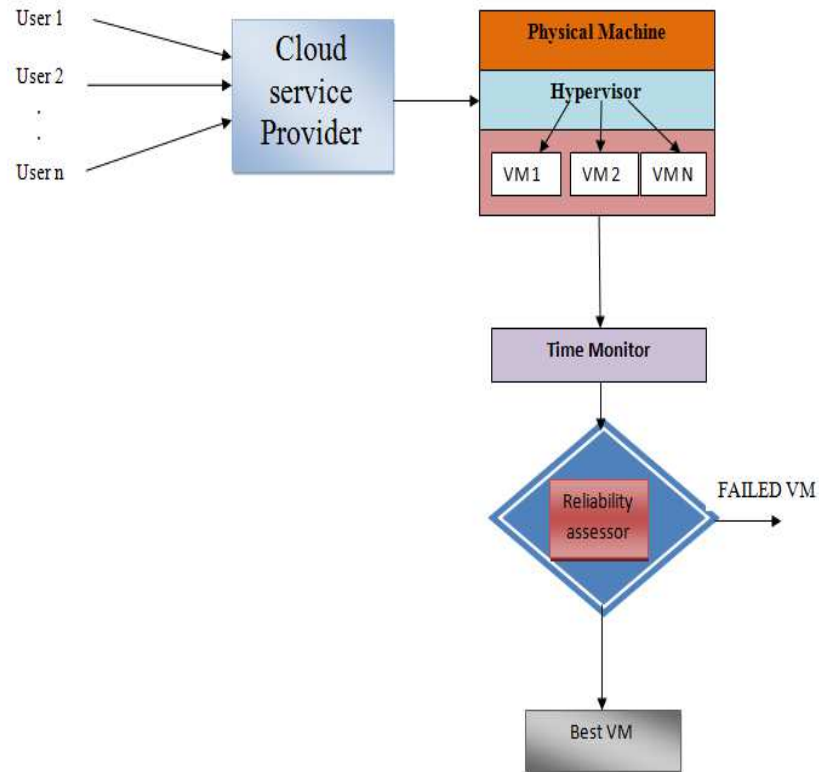


Fig. 4. Architecture of VMFT

RELIABILITY ASSESSOR (RA)

Each virtual machine’s reliability is assessed by the reliability assessor. The reliability is measured based on the time taken by the Virtual machine to execute the application. Initially, all the virtual machines reliability is considered as 100%. For each and every computing cycle the reliability varies according to the performance of the VM. The Virtual machine is observed and analysed to check the reliability. Here, we took 10 computing or clock cycle. For each clock cycle the virtual machine performs multiple instruction execution per second, depending up on the processors speed. For e.g.- An i5 processor speed is 1.80 GHz. In One gigahertz a processor can able to perform a billion – 1,000,000,000 – operations per second. For each computing cycle the reliability of the Virtual machine either increases or decreases based on the time taken it to produce the result. The VMFT technique also has a maximum and minimum reliability level. If the VM does not achieve the minimum level then that virtual machine is removed and the new virtual machine is added instead of the removed Virtual machine. The reliability is increased, if the virtual machine reaches the maximum reliability level and it gives correct output on time. The best reliable virtual machine is the one which gives result on time and it achieves the maximum reliability. That VM is taken for further processing of an application. The system tolerates the fault based on the reliability of the computing nodes (VM). Based on the analysis the comparison is done among all the virtual machine.

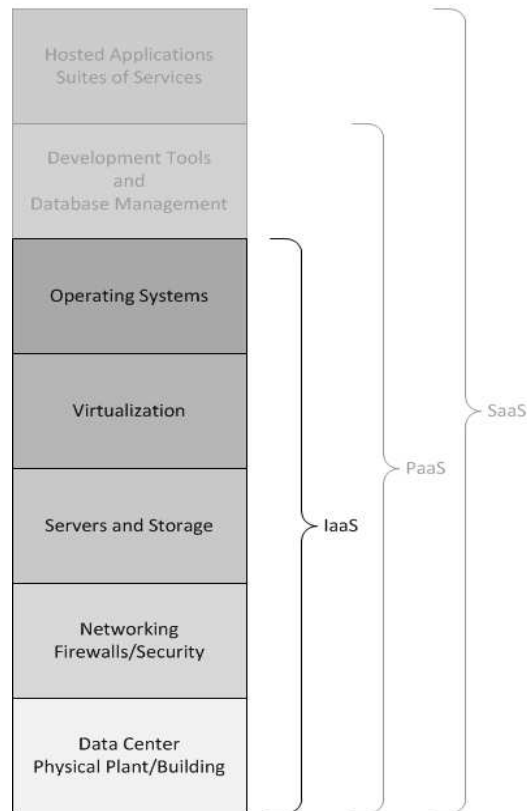


Fig. 5. Services of Saas, Paas, IaaS

OVERALL VMFT PROCESS WORK FLOW AND ALGORITHM FOR RELIABILITY ASSESSOR

Step 1: Setting up the cloud environment by Eclipse IDE.

Step 2: Virtual machine and application are created.

Step 3: Initially all the application is given to the virtual machine at a time for processing

Step 4: Node represents the virtual machine..

Step 5: VM1 represents the first Virtual machine, VM2 represents the second Virtual machine and the VM n represents the nth virtual machine.

Step 6: The time monitor(TM) checks all the virtual machine execution.

Step 7: The machine which gives correct result on time is given to the reliability assessor.

Step 8: Set success Reliability factor =1, Minimum reliability = 0.4, Maximum reliability ≥ 1

Step 9: If the nodes reliability greater than the maximum reliability level, then the nodes reliability increases.

Step 10: If the node reliability lesser than the minimum reliability level, then the nodes reliability decreases.

Step 11: The virtual machine which have the highest reliability factor is consider as best VM.

Step 12: Then the Best VM is taken for executing the application and it is more reliable.

4 SIMULATION AND RESULT

The VMFT technique is implemented in Cloud sim tool. It provides infrastructure and services for modelling and simulation of cloud environment. By using cloud sim we can simulate data centre, virtual machine, cloudlet, application starting time and application ending time, VM status as resembles in the real cloud. It is totally written in java. The cloud sim

package is imported in Eclipse IDE or Net beans IDE. Here all the VM starts their execution at a time .The VM which produces correct output is consider as reliable best VM. Then that VM is considered for further processing of the application.

MODULES

Module 1: Creating Eclipse IDE.

Eclipse is the open source IDE so we can download it from the link [12].

Module 2: Import the cloud sim package in to Eclipse IDE

Cloud sim is an open source where we can create our VM, Data center, Broker, cloud let. It can be downloaded from the link [13] and then Open Eclipse IDE. Then File-->New --> Java Project. Then the cloud sim package is imported in to the Eclipse IDE.

Module 3: Virtual Machine and application are created in cloud sim.

Cloud sim is written in java. So, with the help of default classes we can create the Virtual machine and Data centre. Here three virtual machines are created.

```
// to create the Data centre
Datacenter datacenter0 = createDatacenter
("Datacenter_0");
// to create the virtual machine
Vmvm = new Vm(vmid, brokerId, mips, pesNumber, ram, bw, size, vmm, new CloudletSchedulerTimeShared());
```

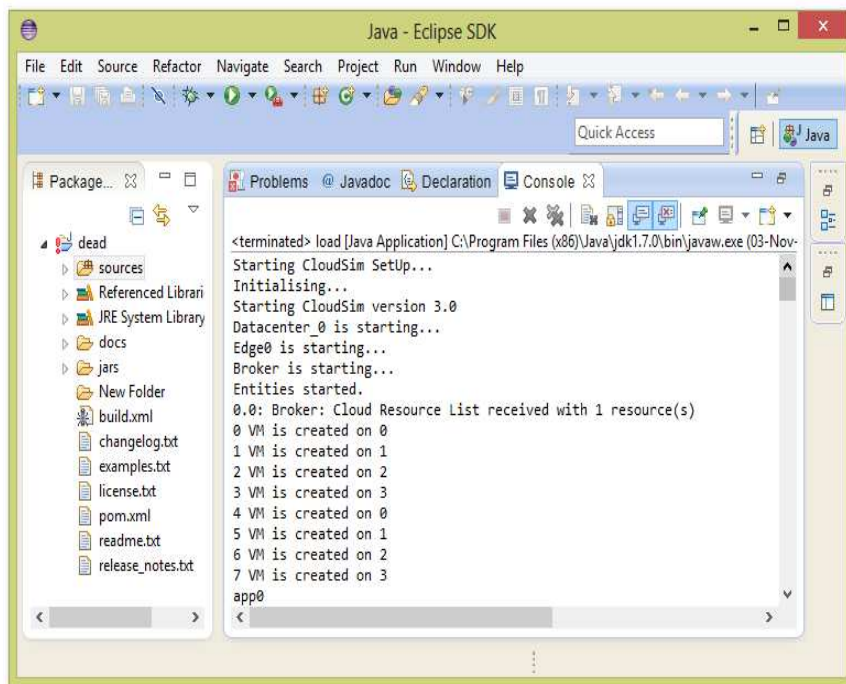


Fig. 6. Virtual machine and application are created.

Module 4: Application execution takes place in the cloud sim

```

Starting CloudSim...
Initialising...
Starting CloudSim version 3.0
Datacenter_0 is starting...
Broker is starting...
Entities started.
0.0: Broker: Cloud Resource List received with 1 resource(s)
0.0: Broker: Trying to Create VM #0 in Datacenter_0
0.1: Broker: VM #0 has been created in Datacenter #2, Host #0
0.1: Broker: Sending cloudlet 0 to VM #0
400.1: Broker: Cloudlet 0 received
400.1: Broker: All Cloudlets executed. Finishing...
400.1: Broker: Destroying VM #0
Broker is shutting down...
Simulation: No more future events
CloudInformationService: Notify all CloudSim entities for shutting down.
Datacenter_0 is shutting down...
Broker is shutting down...
Simulation completed.
Simulation completed.

===== OUTPUT =====
Cloudlet ID   STATUS   Data center ID   VM ID   Time   Start Time   Finish Time
      0      SUCCESS       2             0     400       0.1         400.1
CloudSim finished!

```

Fig. 7. cloudlet id, data centre, Time, VM id, Start time and End time of an application.

Module 5: Based on the computing cycle and the reliability factor we can assess the single nodes reliability.

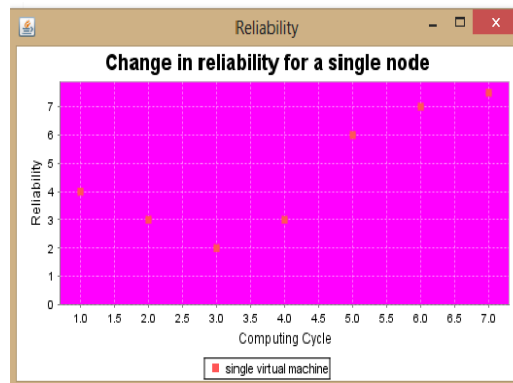


Fig 8 Singles nodes reliability.

Module 6: Reliability comparison of multiple (i.e 3)VM.

Based on the time taken to execute the task the reliability is assessed

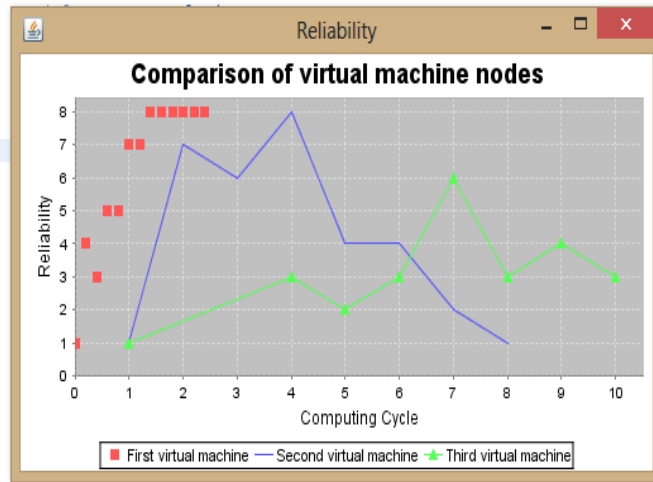


Fig.9. Comparison of three virtual machine reliability.

5 CONCLUSION

Fault tolerance is the major concern in all aspect of business and IT industry. Many safety critical applications are computed on cloud environment for processing it. Because of the scalable virtualized environment the cloud computing provides services to the end user. The Proposed VMFT technique tolerates the fault based on the reliability of the computing nodes. It provides high reliability and availability of resources to the end user. The Virtual machine fault can be tolerated by the VMFT technique. With the help of cloud sim simulator the VMFT technique is implemented. The applications are created and executed in clouds sim. And the reliability of a single node (Virtual Machine) is assessed based on the time it to execute the application. The node which gives the result on time is taken as reliable VM. And the comparison of multiple VM is done. Based on the comparison the best reliable VM among all the three is first Virtual machine which is marked in red colour.

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