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A Survey on Proactive Fault Tolerance Approach in Cloud

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ABSTRACT

Nowadays Cloud has become one of the hot topic. It delivers various on demand services to the customers over the internet and provide online computing platform without buying their own computing infrastructure. Among various challenges in cloud one of them is fault tolerance. Fault tolerance is very important because of occurrence of failures or faults in the cloud. From various problems one of the problems that need to be highlighted is assignment of virtual machines to the cloudlets so that failure rates can be reduced. Fault tolerance techniques can made this possible to overcome cloudlet failure problems. Therefore, this paper includes proactive fault tolerance approach that provides an efficient assignment of virtual machines to the cloudlets so that each and every cloudlet that are taking part for the execution purpose will effectively complete its task before or on deadline without failure.

Keywords:
Cloud Computing
Fault Tolerance
Reactive fault tolerance
Proactive fault tolerance

1. Introduction

Cloud Computing define as the style of computing that deals with the capabilities of information technology to the users as a service and allows the user to use those services over Internet or we can say that ‘ it provide us the advantage by providing services on-demand basis through the Internet. Therefore, Cloud Computing defines as an application and service that are running with the help of available resources on a distributed network. It enables users to use applications without installing them and allow them to access the required resources over the Internet. Cloud computing emerges as a platform that provide new computing paradigm which aims to provide reliability, customized and QoS(Quality of Service) and also decreases the hardware and software demand from user’s side.

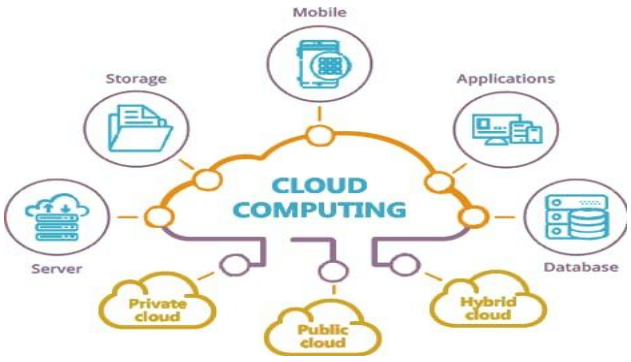

Fig.1. Cloud Computing

As he internet is growing day by day along with its users, features provided by cloud to the users include reliability, pay-as-you-go, high performance, connectivity, interactivity, efficiency, easy programmability, scalability, management of large data and elasticity to transform IT from a product to a service [1].

2. Fault Tolerance

Therefore, cloud have dynamic environment, it causes various unexpected obstacles where as fault tolerance can be taken as a crucial issue in cloud platform and applications. Fault tolerance define as the situation in which system is capable of behaving normally to an unexpected fault or failure [1], [2] & [3].To increase the effectiveness of fault tolerance various models and techniques have been proposed [5].

2.1. Hardware fault tolerance:

Most of the computer systems automatically recover the failures that affect the components of hardware. In case is any one of the component get failed, we can perform function by replacing it with another component. Therefore, with this, each and every component that goes into failure will be protected with the help of its replacement to the redundant component.

Example: For the faults that occur in storage media, Mirroring technology has been used for it. We have further two approaches for this which are given below [2].

Fault Masking:

It defines as the redundancy method in which errors are completely masked in a set of redundant components. Majority of alike components that carry out similar kind of functions, vote the output and the error caused by failing component has been removed from there. Amongst the common forms, TMR (Triple module redundancy) is one from the fault masking in which components are tripled and voted. Anyhow if the components are redundant that can also be tripled so that the amount of failures that occur can be corrected through this voting process. Failure of the TMR also comes into existence when votes are not remaining valid and among that two components get failed [3].

Dynamic recovery:

It includes a special recovery mechanism in at one time only one copy of computation will run and checking process has been done automatically. It is more hardware efficient than that of voted system. Failures and faults are removed by using actions like retry, restart, rollback etc. Actions performed the operation of restoring and again make the execution process on work [3].

2.2. Software fault tolerance:

Failures that arise in the software can also be resolved by same approaches that have been used by hardware fault tolerance. Static redundancy has been used by N Version Programming as a separately written program that performs the same operation. Each module is built with up to N different implementations in N version programming. In this, each programmer performs the same task but in a different way. The result of each version has been submitted to the voter or decision maker. The voter or the decision-maker decides the correct answer and returns it as a result of the module. Also another dynamic approach is a recovery block. In this, program is separated into blocks, and then after each block, acceptance test is executed. Anyhow if the acceptance test fails, then the execution of redundant code block takes place [2].

3. Fault Tolerance Techniques

3.1. Proactive fault tolerance

Proactive fault tolerance define as to predict the fault before it actually comes and make the system fault free proactively by replacing the suspected component. It includes:

- *Software Rejuvenation:* It refers to the technique that designs the particular system for periodic reboots. It provides a fresh start by restarting the system with clean state.
- *Preemptive Migration:* This technique has been done by the application depends upon constantly monitoring and analyzing.
- *Self-Healing:* In this division of tasks takes place. The purpose of this division is improving performance by assigning those tasks to multiple virtual machines.

3.2. Reactive Fault Tolerance

Reactive fault tolerance refers as removing faults on application execution when failure actually occurs. It includes:

- *Check pointing:* In this method a check pointing is done after doing every change in system. When a task fails, instead of starting it from the beginning it is allowed to be restarted from the recently checked pointed state.
- *Job Migration:* Due to any failure if a job cannot able to execute completely on a particular machine, at the time task can be migrated to another machine. Job migration can be implemented by using HA-Proxy.
- *Replication:* In support of successful execution and for getting the desired result, various tasks are replicated or copied and run on various resources.
- *Safety-bag checks:* In this case, those commands have been blocked which are not meeting the

safety criteria.

- *S-Guard:* It depends upon Rollback Recovery. S-Guard can be implemented in HADOOP and Amazon EC2.
- *Retry:* This is a simplest technique that retry the failed task by doing many attempts until the execution purpose complete on the same resource.
- *Task Resubmission:* Whenever a failed task is detected then it may be considered as a job failure also and for the execution purpose, task has been resubmitted either to the same or to the different resource at runtime.

4. Literature Survey

Priti Kumari et al [1] formulate the issue that can be happen related to the fault tolerance which include the concept of various challenges, techniques, models that can help regarding tolerating these issues. This includes a variety of challenges and approaches to increase the reliability also. Concepts of cloud include some of the models like Service, Component and Deployment. Also for improving performance it includes few approaches.

Suruchi Talwani et al[3] proposed a kind of comparative analysis of the work that has been done in cloud that includes fault tolerance that has been already developed by different researchers and also compare the features of various algorithms that are used to solve the problems of fault tolerance in cloud computing. Also it includes that mostly fault tolerance techniques comes under the category of Reactive and Proactive approach. Most of the time Reactive approach come into existence than that of Proactive approach that are not much effective and reliable for tolerance of fault in cloud computing.

Anju Bala et al [2] proposed fault tolerance challenges, techniques and implementation in cloud computing and it includes the existing fault approaches in cloud. These techniques are based upon their policies, tools and research challenges. This paper proposed a cloud virtualized system architecture in which autonomic fault tolerance has been implemented. This shows that the proposed system deals with different kind of faults (that is in the category of software) a cloud virtualized environment for server applications. Also fault tolerance system implementation can be possible by HAProxy and MySQL. HAProxy statistics tool continuously monitored the availability of the servers. To handle the request from web, HAProxy run on web server. In case any server fails then the connection will automatically be provided to another server.

Kalanirnika GR et al [7] proposed a reactive fault tolerance technique to tolerate the fault by using one of the Reactive approaches which is checkpointing. The proposed work include VM-µCheckpoint framework to protect both VM and applications in VMs against transient errors. This uses CoW-PC (Copy on Write-Presave in Cache) algorithm for the implementation of VM-µCheckpoint mechanism which already saves the running task on the cache memory of VMs. In this if any faults occur then it can be removed by using last presaved checkpoint from the cache memory and when the whole task completed successfully then saved checkpoint will be removed automatically from the cache memory and help to improve the performance and low overhead.

Suruchi Talwani et al [6] proposed work that is based on scientific applications. This work is based upon Proactive approach that mainly focuses on effective allocation of cloudlets to the virtual machine for the effective completion of tasks before or on deadline. This provides the Proactive approach for scientific applications and faults are predicted proactively. It shows that proposed system reduced amount of failure and increase the reliability as well as efficiency.

5. Problem Formulation

Fault tolerance is the biggest challenge in Cloud Computing. Making environment of cloud fault tolerant has now become very important. Most of the time fault handled reactively by the tolerant systems and also real time applications has high efficiency as compared to scientific applications. So, it's quite necessary to develop an effective Proactive approach for Scientific Application also that can handle the fault occurred in the effective allocation of Cloud resources proactively reducing the failure rate of cloudlets to a large extent [6]. One important aspect of Cloud Computing is *Virtual Machine Allocation to all the Cloudlets without failure*.

One of the proposed works shows the proactive approach for the scientific applications in which if cloudlets do not get virtual machine according to its execution specification then the cloudlets will split into two parts and then allocated to the virtual machine. If partitioned cloudlet again does not go with the specification of Virtual Machine, the cloudlet will be considered as fail and request for new virtual machine has been generated, which can be time consuming. Therefore its necessary to develop a proactive fault tolerant technique also that can handle the fault occurred in the effective allocation of Cloud resources proactively reducing

the failure rate of cloudlets to a large extent in less amount of time.

6. Problem Solution

One of the method for solving above mentioned problem is that if cloudlet do not get virtual machine up to its execution specification criteria then instead of splitting our cloudlet into two parts and then assigning to the virtual machine, firstly we will check the specification of Virtual Machine and then split our Cloudlet as per the specification of available Virtual Machine that can be more than two parts so that cloudlet effectively complete its execution on time without any failure.

7. Conclusion

The main goal is to work in the area of proactive Fault Tolerance approach and put forward an efficient fault tolerance technique for scientific applications in cloud. There is a need of an effective allocation of cloudlets to the virtual machines so that each and every cloudlet has been executed successfully without any failure. Instead of handling faults reactively it's necessary to focus on removing failures proactively so that it will provide us a smooth execution of all the tasks and do not create any problem in between the execution period. The main aim of this work is reducing the failures through proactive approach and improves the reliability and efficiency of the system where cloudlets can able to execute smoothly without failure and no virtual machine has been left out.

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