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An Investigation of Fault Tolerance Techniques in Cloud Computing

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ABSTRACT

Cloud computing which is created on Internet has the most powerful architecture of computation that provides users with the capabilities of information technology as a service and allows them to have access to these services without having specialized information or controlling the infrastructure. Fault tolerance has. The main advantages of using fault tolerance that has all the necessary techniques to keep active power and reliability in cloud computing include failure recovery, lower costs, and improved performance criteria. In this paper, we will investigation of the different techniques that are used for fault tolerance on cloud computing.

KEYWORDS: *cloud computing, fault tolerance*

1. INTRODUCTION

The growth of cloud computing over the past few years is hypothetically one of the major improvements in computing history. While a lot of research is currently taking place in the technology itself, there is an equally urgent need for understanding the business-related issues surrounding cloud computing. applications and services which are run on a distributed network with the help of available resources. Cloud computing when software and applications are run provides an abstract representation of physical systems [4]. The main advantage of cloud computing is to provide reliability, low cost, high availability, scalability and flexibility for end users which appears as a new computing paradigm [2].

Each of performance and reliability play an important role in cloud computing, because if the service reliability is low, it occasions frequent crashes in the cloud service, which in turn results in a reduction in the number of customers and in the result is a loss for the server. If the reliability of the service is not high, but its efficiency is low, users who ask for services should wait for a long time and this will also be a disappointment to them. So it can be directly related to tolerance to error [3] [2].

Fault tolerance is one of the important issues in cloud computing and is related to all the necessary techniques to enable the system to tolerate the remaining software fault in the system after its development. Fault-tolerance techniques provide reliability and validity in the cloud environment. The main advantages of the implementation of the fault tolerance technique in cloud computing are: failure recovery, low cost, improved performance criteria, and so on [5].

2. Fault tolerance

Fault tolerance is a feature of the system that prevents a computer system or network device from failing due to any fault or failures in system execution. The fault tolerance includes effective steps to prevent such errors or failures in the system [6]. A fault-tolerant system is capable of providing the service in question in an efficient manner if one or more faults or failures occur in system components and the availability and reliability will not be lost of the system. A tolerable bug system is a form that can in the event of a bug, tolerate it and continue to work. Perhaps it's better to have a definition of error at first, because with this word, two words are also mentioned in the mind that is the fault and the failure. But there are three differences between them. Failure: A failure occurs when an expected system is not functioning correctly so, if the system misconduct affords the system to fail at least one of its capabilities properly, then the system is in a malfunction.

Fault: The cause of the failure is a fault in the system. So the fault is a physical malfunction or a failure of a hardware or software component.

Bug: The afford of an error is a bug in the system. [1]. Failure, faults and bugs may occur in applications, virtual machines, and even hardware. The system must be capable of handling the fault and continue to operate. So there are two solutions to this problem:

Fault detection: To provide each evaluation, the first step that a system must perform is identifying the fault functions.

Fault Repair: After the system detects a fault, the next step is to avoid the fault or to improve it.

3. Metrics for Fault Tolerance in Cloud Computing

According to the [7], The existing fault tolerance technique in cloud computing considers various parameters: throughput, response-time, scalability, performance, availability, usability, reliability, security and associated over-head.

- **Throughput:** It defines the number of tasks whose execution has been completed. Throughput of a system should be high.
- **Response Time:** Time taken by an algorithm to respond and its value should be made minimized. Scalability– Number of nodes in a system does not affect the fault tolerance capacity of the algorithm.
- **Performance:** This parameter checks the effectiveness of the system. Performance of the system has to be enhanced at a sensible cost e.g. by allowing acceptable delays the response time can be reduced.
- **Availability:** Availability of a system is directly proportional to its reliability. It is the possibility that an item is functioning at a given instance of time under defined circumstances.
- **Usability:** The extent to which a product can be used by a user to achieve goals with effectiveness, efficiency, and satisfaction.
- **Reliability:** This aspect aims to give correct or acceptable result within a time bounded environment.
- **Overhead Associated:** It is the overhead associated while implementing an algorithm. Overheads can be imposed because of task movements, inter process or inter-processor communication. For the efficiency of fault tolerance technique, the overheads should be minimized.
- **Cost effectiveness:** Here the cost is only defined as a monitorial cost. [8]

4. Types of fault tolerance

Fault tolerance can be classified in two categories of hardware fault tolerance and software fault tolerance. [1]

1. Hardware fault tolerance

One of the main goals of fault tolerance is make the computer system which can automatically recover if multiple random faults occur in hardware components. The developed methods for this work generally include the partitioning of a computational system in several modules. Each module in the system has been redundant Therefore, if the failure occurs in one of the modules, the backup module will continue to work. Fault tolerant methods include two types of error handling and dynamic recovery [9].

Fault coating: fault coating is a structural redundancy technique that completely eliminates faults in a set of mixed components. A number of identical components execute similar functions and their output is voted on to remove faults afforded by a defective module. [1]

Dynamic retrieval: A dynamic retrieval technique is only used when a copy of the work or calculations is made to run at a time. This technique administers self-repair. Like a fault-coating technique, additional spare components are used to perform backup operations.[1]

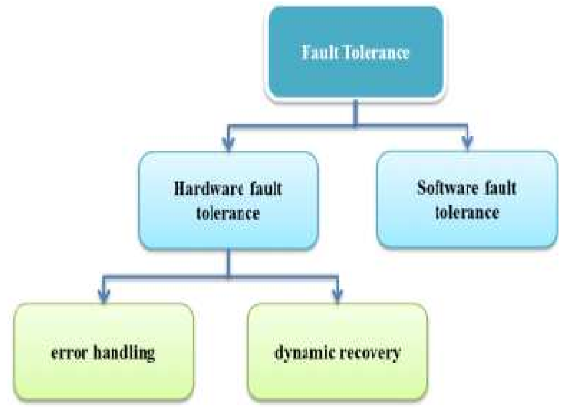

Fig (1): Types of Fault Tolerance

2. Software fault tolerance

Software faults (programming faults) can be exploited using static and dynamic methods similar to those used for hardware fault handling. One of these methods is n-version programming, which uses static redundancy in the form of independent programs. All of them are doing the same thing. There is another method called design variation, which incorporated software and hardware fault tolerance by applying a fault-tolerant computer system using hardware and software in redundant channels [10] the main target of the design diversity technique is to tolerate hardware and software faults, but the cost is very expensive. [1]

5. Downside of a Fault Tolerant System

According to [11], Here is a short list and brief description of fault tolerant design disadvantages:

Masking or obscuring low-level failures

The nature of a fault tolerance design is to continue to operate normally even with a component failure. Thus if the ability to detect a component failure relies on a loss of function or capability, it may be difficult to detect the failure. This sets the stage for a second component failure to cause a system downing event. Being able to detect individual component failures permits the repair or replacement of faulty elements restoring the system to full fault tolerance capability.[11]

Increase in testing challenges

Similar to the inability to detect some single point failures, the ability to test the functionality and parametric values of components is also limited by the nature of the fault tolerance design. It may require additional test functionality designed into the system, further adding to the complexity of the system. [11]

Increase in cost, weight, and complexity

Redundancy, error checking, and fault isolation designs, as examples, add components and logical elements to a system. This increases the weight, due to the added components, board size, and power requirements. It also adds complexity by including parallel, and complex circuit and logic required to detect and ignore (functionally speaking) single point failures. Add parts and complexity, additional cost. [11]

Reduction in emphasis on improving component or subsystem reliability

The design team may not focus on improving the inherent reliability of elements of a fault-tolerant system. This tends to occur as the priority is on identifying single point failures and creating a design that is resilient enough to continue operation. The focus in system availability and not necessarily on system reliability. [11]

Increase in acceptance of inferior components
Similar to the loss of focus on inherent reliability, the team may accept the lower cost and inferior component despite the increasing frequency of component failures. Again the focus on system availability and robustness even with component failures lose priority as the design demonstrates its ability to meet fault tolerant requirements. [11]

Increase in support and maintenance expenses
The lack of focus on reliability and the increased use of inferior components causes an increase in component level failures. These failures then require replacements and repairs of the affected systems. This increases the cost of operation of the system.

Fault-tolerant design is for specific applications where the added cost, weight and complexity along with the other downsides to this approach are worth the expenses. A good team will focus on both the system availability along with the cost of operation/maintenance and the inherent reliability of the individual elements. [11]

6. Conclusion
Cloud computing has become a generally used computing technology and very popular in today. It must be reliability and availability for user and requires utilize of tested tolerance methods which can manage any kind of fault in every feature. Fault tolerance techniques are used to expect these failures and take the necessary actions before the damage happened. Reliability and availability are two important parameters in cloud computing. Therefore, we need a fault tolerance method that will prepare the services provided in cloud computing against the resulting faults and failures. There are a number of fault-tolerant techniques in the cloud, this paper tries to investigate a proper and efficient model that covers the most aspects of fault tolerance in cloud computing, In the future, it is also expected to better understand the types of faults in hardware, software, and cloud infrastructure by providing other models of architecture with higher fault tolerance, higher reliability, availability, and more impressive performance.

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