Fault tolerance in cloud

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Abstract: - In order to guarantee the constant availability, dependability, and scalability of cloud services, fault tolerance is a crucial component of cloud computing. Many companies and organisations now depend heavily on cloud computing, and any malfunction could have dire repercussions. Therefore, creating fault-tolerant systems for the cloud is essential. The significance of fault tolerance in cloud computing, different methods for achieving fault tolerance, and the difficulties in implementing fault tolerance in cloud computing are all covered in this paper.

Introduction: -

The way companies and organisations utilise technology has been revolutionised by cloud computing. Scalability, flexibility, and cost efficiency are just a few benefits of the cloud. However, these companies and organisations depend on the dependability and accessibility of cloud services to succeed. Any malfunction or downtime may result in income loss, reputational harm, and unsatisfied clients. Therefore, a key component of cloud computing is failure tolerance.

Methods for Achieving Fault Tolerance in Cloud Computing:

There are several methods for achieving fault tolerance in cloud computing, including redundancy, replication, and resilience.

Redundancy:

To prevent a single point of failure, redundancy entails replicating crucial system components. In

Redundancy in the cloud can be accomplished at various levels, including those for hardware, software, and data. In order to ensure high availability, hardware redundancy entails using multiple physical servers, network components, or storage systems. Utilizing virtualization tools like VMware or Hyper-V to run multiple instances of a programme on various virtual machines is known as software redundancy. To ensure data availability, data redundancy entails replicating data across numerous storage devices or data centres.

Resilience:

The term "resilience" describes a system's capacity to bounce back from setbacks and adjust to shifting circumstances. Resilience in cloud computing can be attained through fault isolation, automated recovery, and monitoring methods. Continuous system fault and failure tracking is part of monitoring. Utilizing automated programmes or tools to fix errors and failures is known as automated recovery. To prevent cascading failures, fault isolation entails separating out the system's problematic components.

Ease of Use and Working of Fault Tolerance Methods in Cloud Computing:

Redundancy, replication, and resilience are widely used methods for achieving fault tolerance in cloud computing. These methods are easy to use and work seamlessly in the cloud computing environment. Redundancy and replication can be implemented using cloud-based services such as Amazon Web Services (AWS) or Microsoft Azure. These cloud-based

services provide high availability and scalability at a lower cost. Resilience can also be achieved using cloud-based services such as AWS CloudWatch or Microsoft Azure Monitor. These services provide monitoring, automated recovery, and fault isolation capabilities to ensure high availability and reliability.

REVIEW OF LITERATURE: -

Numerous frameworks, models, methods, and strategies for fault tolerance have been created. In this study, all fault tolerance models have been surveyed and analysed. Tandem-16, the first fault-tolerant computer, was created in 1975 with the goal of handling online transactions. Felix C. Gartner studied failure tolerant distributed computing later in 1999.He reviewed the fault tolerance methods, talked about how they relate to one another, listed their benefits and drawbacks, and examined how these methodologies affect the system. This paper's emphasis on the fault tolerance reliability feature was a key component.

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In 2011, Arvind Kumar investigated various fault tolerance and defect detection techniques based on reliability. The focus was on different system fault types, as well as fault detection and recovery techniques. The emphasis of this paper has been on how these methods can be used in real-time distributed systems to detect and tolerate faults even in the presence of hardware faults. It discussed load sharing and redundancy, two crucial methods of hardware failure tolerance. The primary prerequisite for tolerating a fault that happens in the system is to identify the fault and then isolate it to a different unit. Protocol errors, In Service diagnostics, Watchdog monitoring, and Transient are some of the main detection methods discussed in this paper.In order to address the reliability and fault tolerance issues, J. Deng in proposed a decomposition matrix multiplication scheme. This technique helps to analyse various tasks and their corresponding behaviour in different clouds. The idea primarily focused upon scientific computations in cloud environment. This scheme also helps to find faulty clouds in the network can also find out faulty clouds in an intellectual way.

After the fault has been detected in the system there is requirement of analysing it and then removing it. For this purpose, several fault tolerance models have been developed. Some of them are described below:

AFTRC: - The idea behind AFTRC, or Adaptive Fault Tolerance in Real Time Cloud Computing, is that real-time applications can be applied in the cloud environment by utilising cloud virtual nodes. In this model, fault tolerance is dependent on the processing node's dependability and determines whether it should be included.

- LLFT, or Low Latency Fault Tolerance, is a fault tolerance model that includes middleware that supports distributed applications set up within a cloud computing system. This middleware replicates the application using different replication methods in order to offer protection against a variety of faults. It offers defence against accident costs and trimming errors. FTM i.e. Fault Tolerance Model was developed to accomplish the reliability and hence helps to manage the fault tolerance. This mechanism permits the user to apply desired level of fault tolerance without any requirement of prior knowledge about its implementation. FTM architecture can be viewed as collection of various web services components, each having its functionality. In short it focuses on reliability, availability and on demand service.
- Candy is a component-based availability fault tolerance model. This model focused on the fact that high availability is not only an important

feature of cloud service but also serious and stimulating issues for the cloud service provider.

Magi-Cube is extremely reliable and low redundancy storage architecture developed in cloud computing. This fault tolerance model describes that high reliability, performance and low cost (in terms of space requirements) are the major inconsistent components in a storage system. To facilitate these services to a specific model Magi cube framework was proposed. It focuses on Performance, reliability and low-cost storage.

PROBLEM DEFINITION: -

OBJECTIVE: Through cloud resources, cloud computing currently offers customers a wide range of services. The presence of a significant amount of data in a cloud environment has led to an increase in errors. Tolerating and managing flaws, or achieving fault tolerance in cloud computing, is thus the main challenge. The ability of a system to gracefully recover from an unanticipated hardware failure, programme failure, or other type of error is measured by its fault tolerance. This essay has discussed different fault types, fault tolerance techniques, fault tolerance architecture, and a study of current fault tolerance techniques.

SCOPE: In this modern technological world, cloud computing is gaining tremendous popularity day by day. More is data present in the cloud; more are chances of error occurrence. Considering this fact, in this paper we have glanced upon various types of faults that can occur in the cloud, different methods to tolerate the faults, challenges of fault tolerance in cloud computing and analysis of existing fault tolerance techniques is done. With more efforts and technological research in this area, the drawbacks of the existing techniques can be eliminated and across the databases. However, the search was limited to peer reviewed scholarly journal articles from 2009 and till 2015. The articles were subjected to manual filtering where editorials, review articles, and reports were eliminated. Because the study set out to include only peer reviewed articles in the review. Conference papers, dissertations, books, working papers, and reviews of books were also excluded. Further checks were conducted to remove duplicates and articles from other disciplines such as computer engineering. In all, 285 articles from 67 journals were considered for classification and analysis.

Related Technologies

The paradigm of cloud computing has contribution of many technologies such as parallel computing, grid computing, utility computing, virtualization,

Autonomic computing, Software as a Service, web 2.0 and distributed computing. Various technologies related to cloud computing are:

- **Parallel computing:** The concept is to divide the computing problem which is scientific into many small tasks and run them at same time.
- **Grid:** It is used to shift the workload to place which requires computing resources that are remote and immediately available to use.
- **Utility Computation:** It has resources based on clients demands and charging them according to use.
- **Virtualization:** It separates the underlying physical hardware and provide virtualized resources to the applications.

Cloud computing technologies

There are 5 main categories:

- On-Demand Self Service
- Broad network access
- Resource pooling
- Elasticity

- Measure service

DATA ANALYSIS & FINDINGS

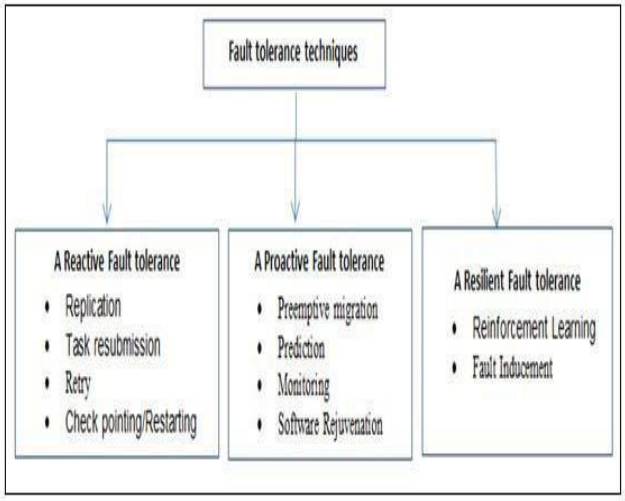
Now let us consider the following existing fault tolerance techniques:

1.) **Retrying***:* The failed task is retried on the same resource.

2.) **Alternate resource:** The failed task is retried on another resource.

3.) **Check-pointing:** The failed task resumes processing from the last saved checkpoint instead of from the beginning.

4.) **Replication***:* Different replicas of the same task are processed on different resources simultaneously.



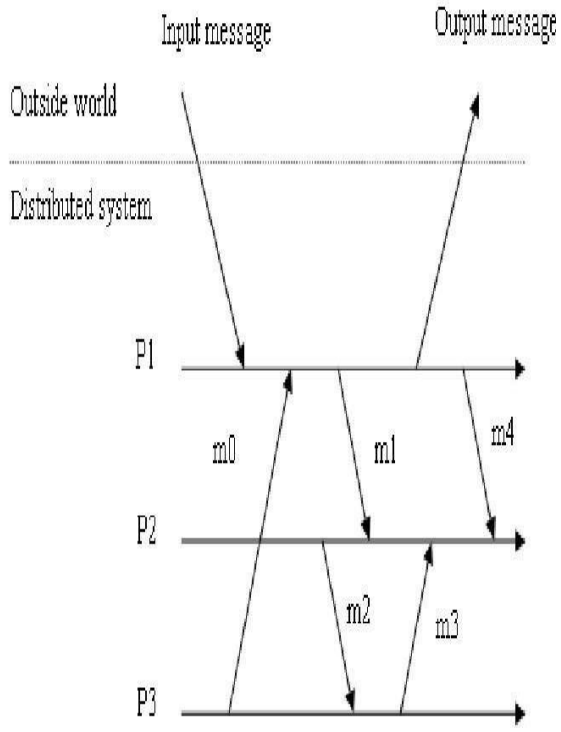
Each technique has its own advantages and disadvantages.

The retrying technique is the simplest technique being used. Both the retrying and alternate resource techniques are not time efficient as when a task fails, it must be restarted from the beginning as a result it consumes more time.

The replication technique is resource demanding since replication means duplication. For the achievement of desired results and successful execution various tasks are duplicated and permitted to use different resources.

As compared to above techniques, the checkpointing technique consumes more storage space as it needs to store lots of checkpoints. Whenever any failure is encountered, the job is permitted to start from the point where last checkpoint was placed rather than from the beginning. Hence it results in less time consumption. Certain fault tolerance models have also been developed that are based upon check-pointing technique.

external interactions with the outside world.



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Conclusion

Fault tolerance is a critical aspect of cloud computing to ensure continuous availability, reliability, and scalability of cloud services. Redundancy, replication, and resilience are effective strategies for achieving fault tolerance in cloud computing. However, implementing these strategies can be challenging and expensive. As cloud computing continues to evolve, it is essential to address the challenges of fault tolerance to provide users with reliable and high-performance cloud services.

SCOPE FOR FUTURE RESEARCH

In this modern technological world, cloud computing is gaining tremendous popularity day by day. More is data present in the cloud; more are chances of error occurrence. Considering this fact, in this paper we have glanced upon various types of faults that can occur in the cloud, different methods to tolerate the faults, challenges of fault tolerance in cloud computing.

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