

# Methodical Review on Various Fault Tolerant and Monitoring Mechanisms to improve Reliability on Cloud Environment

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## Abstract

**Background/Objectives:** Cloud computing is an emerging area that is currently pulling towards many of us. Cloud deployment is a difficult task in this layered structure. Handling the cloud environment itself an optimally a challenging job. This can be made feasible by using fault tolerance and monitoring services. **Methods/Statistical Analysis:** Fault Tolerance (FT) facilitates the process or the component to work smoothly even though in the occurrence of failure. Monitoring is a technique collects the information and to predict the fault before it occurs. Proactive and reactive measures can take place to run the cloud environment with tolerance in failure occurrence. Reviewing the potential of FT and monitoring services is to make out the technique that serves in certain purpose. Fault tolerance systems are important for both cloud provider and cloud customer. **Findings:** Based on this idea, this paper provides the different or diverse fault tolerance and monitoring mechanism to improve the reliability in a cloud environment. **Applications/Improvements:** It presents the information about the various techniques and methods used in the FT and also a future research direction in cloud FT.

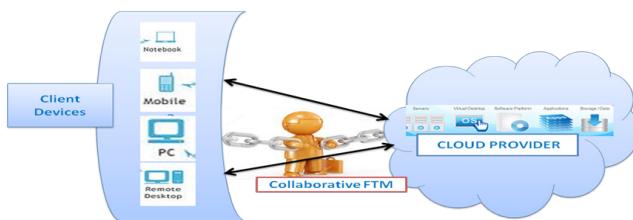
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## 1. Introduction

Cloud computing is providing the any resources as a service through internet on demand. Applications are run on hosted servers and provide as a service. Cloud computing is a metaphor for the internet. It allows accessing the application that actually resides at a location other than the computer or other internet-connected device. Handle the cost of servers; manage the software updates everything takes over by cloud providers. There are four categories of the cloud deployment model defined by NIST (1) public (2) private (3) community (4) hybrid. Infrastructure owned by public cloud service providers for commercial purpose is public. google; amazon, Rackspace, etc. are some of the public cloud providers. Infrastructure built for a single enterprise is private cloud. infrastructure shared by multiple organizations for a common purpose is community. Combination of different deployment model is hybrid Qian L. et al<sup>1</sup>.

Reliability and security are major challenges in a cloud environment because resources are in on-site. Reliability means a component that consistently performs its operation within a specified time Daniel W.<sup>2</sup>. A failure is when a hardware or software has failed to complete its running. In a cloud environment, Failure arises to make the resources unavailable to the cloud customer. It results lack of reliability. A key feature to improve the reliability is by using Fault Tolerance mechanisms and monitoring service. In general, there are two types of Fault Tolerance (FT) policies (1) Proactive FT (2) Reactive FT. Egwuoha I. P. et al<sup>3</sup>. A proactive FT policy is a method of avoiding the failures by predicting them earlier and swaps the component with other working component. Methods used for proactive FT are preemptive migration, software rejuvenation, fault induction and monitoring, etc. A reactive FT policy is a method of reducing the effect of failure on application execution when the failure effectively occurs.

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**Figure 1.** Fault Tolerance Mechanism (FTM).

Various reactive FT techniques are checkpoint/restart, Replication, Retry, Task Resubmission Bala A. et al<sup>4</sup>.

His survey paper deals with the methods propose for Proactive and Reactive Fault Tolerance and monitoring services in the cloud environment. Lingfang Zeng et al.<sup>5</sup> proposed an algorithm for workflow scheduling called an Adaptive Data-Aware Scheduling (ADAS). It improves the makespan in communication-intensive workflow applications and in workflow application with degree of parallelism.

## 2. Proactive Fault Tolerance Methods

Hamid Reza Faragardi et al.<sup>6</sup> proved by analytical model based on application and resource constraints. For application task precedence structure and QoS were taken as limits and for resource every server's memory and storage constraint and each links extreme communication load. EDF (Earliest Deadline First) algorithm used as a scheduler in each processor. Task Interaction Graph used to represent tasks of service. He proposed resource allocation approach based on QoS to improve reliability in cloud computing systems. Amal Ganesh et al.<sup>7</sup> emphasizes Fault Tolerant by considerate Reactive and Proactive FT policy. In Proactive Fault tolerance policy preemptive migration and software rejuvenation techniques were discussed. Checkpointing/restart, replication and Task Resubmission were discussed in Reactive Fault Tolerance policy. Alain Tchana et al.<sup>8</sup> put forward by mutually split the responsibility between the cloud customer and provider in the proposed Fault Tolerance method in order to make available the required Fault Tolerance. In customer level, application faults can be noticed and renovated whereas at cloud provider level, virtual machine and hardware faults can be noticed and renovated. The recovery/restoration of the applications running on the renovate VMs can be requested and performed at the customer level. Checkpointing technique is used to create restore points for the recovered VMs.

Chen-Tung-Yang et al.<sup>9</sup> proposed Medical Image File Accessing Systems (MIFAS) to improve medical image storage, transmission constancy and availability using HDFS of Hadoop in cloud between different hospitals. MIFAS achieves high reliability using Fault Tolerance capabilities and improve the performance of file accessing with less cost of medical resource redundancy. This system can be further enhanced between patient and caregivers. Jingwen Zhou et al.<sup>10</sup> proposed trade-oriented monitoring method to improve the efficiency and reliability of cloud system by monitoring using runtime verification method. Validation of proposed approach was proved by monitoring some critical properties of HDFS based on Trace Bench. In future, already Existing Runtime verification method like CaRet RV integrated with proposed trade-oriented monitoring. Improve efficient and scalable trace-oriented monitoring method. Traced information can be used for performance assessment in future.

Eun-Ha Song et al.<sup>11</sup> proposed a technique that supervises the trusted state of a computing called M-TMS (Mobile Trusted Monitoring System). In which a TPM chip-based TPB was mounted and the current status of its system resources in a mobile device environment resulting from the development of network service technology. Resources of CPU, RAM and process were monitored by providing me-TMS to user's system. Moreover, converting and detouring single entities like a PC or target addresses, which are attacking pattern methods that pose a threat to the computer system security are combined. In future work m-TMS's will concern with notifying users of possible locations of logical errors caused by the attacks, the possibility of attack on each process and the occurrence of problems with a trusted state. Chen-Fu Cheng et al.<sup>12</sup> said that some malicious faulty components may agitate job scheduling of fault-free servers, which leads to the incompatible scheduling of resources. In his paper he examines the Interactive Consistency (IC) problem in the cloud environment and built a new IC protocol called Efficient Interactive Consistency Protocol with weight consideration (ECIP weight). In proposed method every server will gather job request from end-user and according to its job weight will be provided and create a consistent schedule of job based on their weight. This exempts the authority from malicious faulty components and help server to achieve consistent job scheduling. To evaluate the performance cutoff-test mechanism was proposed.

J. L. Gonzalez et al.<sup>13</sup> puts forward a resilient Content Delivery Service (CDS) called SkyCDS based on a publish/subscribe overlay over expanded cloud storage. It divides the content delivery into metadata and content storage flow layers. In the future, he is working on a load balancing system for achieving a trade-off between addressing the concerns of the content delivery users and the utilization of storage resources. A. Kertesz et al.<sup>14</sup> said that because of system malfunctions, changing workload conditions, hard- and soft-ware failures, established SLAs may be under breach. In order to shun SLA violation he presents self-manageable architecture for SLA-based virtualization. It's a way to ease interoperable service executions in a diverse, heterogeneous, distributed and virtualized world of services. Liying Wu et al.<sup>15</sup> put forward Dynamic Data Fault tolerance of Cloud Storage (DDFMCS) mechanism to improve cloud storage. Access the file frequency ratio and update in frequency table. Hadoop was used to implement and show the effective utilization of DDFMCS mechanism.

### 3. Reactive Fault Tolerance Method

According to Chen-An Chen et al.<sup>16</sup> mobile devices connected in networks were dynamic in nature, that cause node failure easily and also not addressing the reliability and energy efficiency challenges. He proposed K-out-of-n computing to address the above mentioned challenges in a combined manner of data storage and processing mobile cloud. As long as k out of n remote servers were accessed, then mobile device can successfully retrieve or process data. By using K-out-of-n method, jointly addressed the energy efficiency and Fault Tolerance challenges. Fragmented data in nodes used to retrieve data reliably with minimal energy. Ravi Jhawar et al.<sup>17</sup> presented a method to evaluate Fault Tolerance mechanism with virtualization technology to improve the reliability and availability of an application deployed in VM's in a cloud. Coalition of component, network and power distribution failure is taken into account. Methodology to choose Fault Tolerance mechanism according to the user's requirements was also proposed. Future direction in this paper is to extend the model for large scale dynamic change cloud environment. Chao-Tung Yang et al.<sup>18</sup> proposed Virtualization Fault Tolerance (VFT) with three main phases: virtual machine migration policy, information gathering which remains services always available.

Upcoming improvement in this paper is to broaden fault-tolerance work beyond failure management in order to enable better utilization of virtualization cluster resources. Abid et al.<sup>19</sup> suggested technique Antifragility, learning from failures and put up a flexible and resilient cloud infrastructure. He proposed with three mechanism fault induction, monitoring and learning. In failure indication, inject the possible failures in production environment and provide an idea of failure embracing. It's a better preparation for predictable failures will occur in future. Proposed unsupervised behavior, learning, system for the cloud. Upcoming enhancements are proposed architecture for anomaly management system and analyzing data from both VM's and PM's to get better system quality.

Kuan Lu et al.<sup>20</sup> detailed utility architecture with actor system to optimize resource deployment and mechanism for optimized SLA negotiation. Parallelism of all SLA management can be achieved using an actor system. Realistic approach for automated management, SLA lifecycle was proposed. Multi autonomous layer that can be combined with intuitive, parallelized, effective and efficient management structure proposed to attain Fault Tolerance. Bala A. et al.<sup>21</sup> cloud provider maintained resource manager to keep up the consistent view of resources for effective distribute of fault tolerant services to the cloud. The Fault Tolerance delivery scheme can clearly put into effect the Fault Tolerance properties on the client application. Design a framework incorporate easily with the existing cloud environment and achieve a provider's goal. Execution of scientific workflow is in the form of data flow and dependency, so the user has to multi step the complex computation tasks. In this situation, proactive Fault Tolerance policy is required for execution. In this circumstance, intelligent predicting Fault Tolerance policy is needed. This can be proposed by machine learning approach using naïve Bayes methods. Fan G, et al<sup>22</sup>.

Fault detection in cloud environment is critical because of its dynamic nature. For this propose a model called Byzantine fault detection technique. Basic properties like service resources, cloud module, detection and failure process were modeled using the cloud Computing Fault Net (CFN). Petri nets used to find the effectiveness and correctness of the model Malik S. et al.<sup>23</sup> model for reliability assessment was proposed for general application and real time application based on time based reliability based algorithms. The assessment

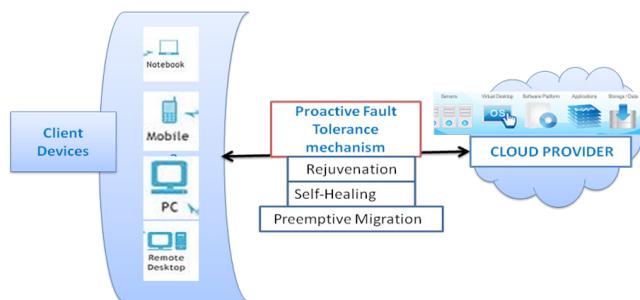
was used for scheduling cloud resources and was helped for performing Fault Tolerance. Virtualization and Fault Tolerance (VFT) technique was proposed to cut down the service time and improve the system availability. To manage virtualization, load balancing and fault occurrence, scheme called cloud manager and decision maker was introduced. Virtualization and load balancing were performed in the first stage and Fault Tolerance was obtained using redundancy, checkpointing and fault handler in second stage. VFT was under reactive Fault Tolerance policy Das P. et al<sup>24</sup>.

## 4. Monitoring Service

Andreolini et al.<sup>25</sup> propose an adaptive algorithm for monitoring big data applications that adapts the intervals of sampling and frequency of updates to data characteristics and administrator needs. Adaptively allows us to limit computation and communication costs and to guarantee high reliability in capturing relevant load changes. The proposed adaptive algorithm to reduce resource utilization and communication overhead of big data monitoring without penalizing the quality of data and demonstrate our improvements to the state of the art. Brinkmann A. et al.<sup>26</sup> illustrate a scalable monitoring system for cloud computing that is currently developing in the EASI-CLOUDS project. The monitoring data are locally composed from a variety of suppliers, but integrated in a global tree structure that provides location-transparent access to them via a generic interface. To potentially adapt the monitoring data to the requirements of the subscribers, the system has a context processing platform for data storage and pre-processing. Jemina Priyadarsini et al.<sup>27</sup> proposed method called parallel Bee Colony Optimization Particle Swarm Optimization (PBCOPSO) and is a combined method of BCO and PSO in parallel manner which leads to better quality and faster execution time.

**Table 1.** Current cloud monitoring tools

S.No	Tools	Services
1)	AppDynamics	Application Monitoring
2)	Aternity	End-user management tool
3)	Boundary	Provides warning about cloud problem in early stages
4)	CA Nimsoft Monitor	On-premises monitoring
5)	Compuware Gomez	SaaS-based platform for application performance management tool
6)	CopperEgg RevealCloud and RevealUptime	Used by cloud service provider
7)	Level Platforms Managed Workplace	monitor public cloud platforms like Office 365
8)	LogicMonitor	Cloud monitoring tool
9)	ManageEngine	Offers cloud monitoring tools as well as Amazon monitoring tools
10)	Monitis	Proactively manage and monitor customer environments
11)	NetEnrich	Cloud monitoring and management for VARs and MSPs that need third-party assistance
12)	New Relic:	Application monitoring and server monitoring.
13)	Rackspace Cloud Monitoring	Monitor third-party cloud services using Rackspace's tools
14)	SplunkStorm	Ability to help IT managers analyze and troubleshoot cloud application performance issues.
15)	Zenoss Cloud Monitoring:	Unified monitoring solutions for vCloud, Cisco UCS and NetApp Flexpod



**Figure 2.** Proactive Fault Tolerance Mechanism.

## 5. Conclusion

Fault Tolerance and monitoring service in the cloud environment play an important role in supporting the well-organized cloud infrastructure. This survey paper reviewed the various Fault Tolerance and monitoring service techniques. Algorithms and methods propose in various proactive and reactive Fault Tolerance policies are analyzed. In future to improve the reliability in

cloud infrastructure, one direction is to collaboratively cloud provider and customer share their responsibilities between them to perform effective Fault Tolerance. And also combined proactive and reactive Fault Tolerance mechanism will be proposed.

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