RELIABLE CLOUD BASED ARCHITECTURE FOR MULTILEVEL FAULT TOLERANCE

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Abstract: *Cloud computing is the sharing of resources through the internet which is geographically independent and it also offers less cost. It is the evolution of scalable resources and on demand self-service. Today many users offers the benefits of cloud computing. In cloud we can access and process the data at anywhere at any time in the world. Today, with the help of cloud environment we can remotely access the real time application. It provides many services such as wide range of network access, rapid elasticity, resource pooling, etc. However, when we access those application in the cloud environment there may be a chance of fault and the detection and recovery of fault are the key issue. To reduce the impact of the fault, many fault tolerance techniques have been designed. In this paper the fault tolerance for the real time application is achieved in two levels. In the first level the system achieves the high reliability for the virtual machine and in the second level the system achieves high availability of data through replication mechanism. Thus the system achieves both high reliability and availability of data. So we can tolerate the fault in the multi-level fashion.*

KEY WORDS: Fault Tolerance, Reliability, Availability, Replication, Virtual Machine, Replicas

I.INTRODUCTION OF FAULT TOLERANCE AND ITS RELATED WORK

Cloud computing refers to manipulating, configuring, and accessing the application over the internet [1][2]. It provides Infrastructure where our application data can be stored. Today, Business organizations have difficulty to maintain their internal infrastructure to store their data and it also consumes more cost. So, many business organizations move their confidential data onto the cloud with the help of cloud service provider [1].

Fault tolerance is the ability of cloud computing nodes to operate continuously even in the presence of faults. It is the quick replacement and repairing of faulty nodes in case of failure. The fault may arise due to hardware fault, Virtual Machine Fault, Network congestion and Application Fault. [3][4].The main purpose of Fault tolerance techniques are used to provide the robustness and dependability for cloud computing nodes [4].
Mohammed et al. [24] proposed smart failover strategy (SFS) to ensure high availability of critical cloud services, the application execution, and hardware performance. Propose an optimized FT strategy in real-time cloud computing environment to increase system availability, reduce the service time, and enhance rapid and efficient recovery from faults. To address the problem of job completion time, they integrated the PR-optimized selection technique with a job check pointing mechanism in the SFS approach. This greatly decreases the system re-computing time. But it was not suitable for more complex and large-scale high-performance environment

*"*Sheheryar Malik et al (2011)"AFRTC is an Adaptive Fault Tolerance in Real Time cloud computing. In this method the fault can be tolerated and the decision can be made based on the reliability of the VM processing node. If the virtual machine continues to fail then the new node is added and the failed node is removed. If the virtual machine does not achieve the minimum system reliability level, then it system performs backward recovery [10].

"Jayadivya S.K et al" FTWS is a Fault Tolerance Work Flow scheduling algorithm. This algorithm provides Fault Tolerance by using replication and resubmission of task based on the precedence followed in the heuristic metric. Based on the data and control dependency the set of task is processed in a work flow manner. When failure takes place, scheduling the task is the major challenge in the cloud environment. In this proposed model by using FTWS it replicates and schedules the task to meet the deadline of the task completion [11].

"AnjuBala et al (2014) this paper mainly focused for scientific work flow applications. An intelligent task failure detection model is used for providing proactive fault tolerance by predicting the task failure earlier. It consists of two modules. In the First module, machine learning approaches are used to predict the task failure. In the second module, actual failures are located after executing the workflow execution in the cloud test bed. To predict the task failure intelligently from the data set of scientific workflows, the machine learning approaches such as Naïve Bayes, ANN, Logistic regression and random forest are implemented [12].

"Geoffroy Valleeet al" It consists of master and compute node. The master node contains the Policy Daemon (PD) and the compute node contains the Fault Predictor and the Fault Tolerance Daemon (FTD). The compute node computes the application. The fault predictor predicts the fault in case of malfunction in the compute node by using lm sensor and sends an alarm signal to the PD. When the alarm signal event is received by the PD it triggers the appropriate fault tolerance policy in the daemon. It sends either pause/un pause or migration to the FTD. The FTD implements the fault tolerance protocol in the compute node .Based on the policy received from the PD it performs the action [13].

"JasbirKaur et al.(2014**)"** In this proposed work if the processing server becomes faulty ,then it reallocate the faulty server task to the new server which has minimum load when the fault occurs. Here the comparison of MPI and MPIL is done. Based on the comparison, MPI takes more time to check the cause for un execution of the task, but MPIL contains look up table and checkpoint techniques are used. From that comparison, MPIL is better than MPI. And also MPIL consume less energy when compared to MPI [14].

"Dhananjaya Gupta et al.(2013)**"**It is used to provide fault tolerance automatically for web application .It consist of the load balancer, web engine, HADOOP cluster, and monitor. Load balancer gets the request from the web application and forward it to the web interface. If the web interface, process another request, then the load balancer forwards to the other web interface. Web engine process the request and provide services and stores the data in the storage cluster. HADOOP clusters maintain replication to provide availability of data. Monitor tools are used to provide alert signal if the component is failed [15].

Liying Wu et al (2013)"For handling data level fault they introduced Dynamic Data Fault Tolerance Mechanism for cloud storage (DDFTMCS). It is implemented by using HADOOP. It dynamically determines the data fault tolerance by a file access frequency ratio stored in the file access frequency table. Based on the threshold limit it will delete the infrequently accessed data automatically [16]

"A.Tchana et al (2012)"In this work both the cloud provider and the consumer combined together to provide effective fault tolerance. The applications fault is repaired and detected by cloud consumer. The virtual machine and hardware fault are detected and repaired by the cloud provider. For the recovered VM's, restore points are created by using check pointing technique [17].

"P.Das et al. (2013)**"** Virtualization and Fault tolerance (VFT) techniques are used to provide increasing system availability and reduce the service time. It consists of Cloud Manager (CM) and the Decision Maker (DM). In the First step it performs load balancing

and virtualization and in the second step it performs FT by redundancy, Fault Handler and check pointing [18].

Y.Zhang et al (2011)**"** They propose BFT cloud, a Byzantine Fault tolerance Framework for cloud computing. The basic technique replication is used. It guarantees that the system robustness is when up to f of totally $3f+1$ resource provider are faulty including behaviour\ and crash faults [19]

"Wengbing Zhao et al (2010)"they proposed Low Latency Fault Tolerance (LLFT).The cloud owner used to provide fault tolerance in distributed cloud environment. It follows the leader/follower replication approach. It consists of Low Latency messaging protocol, Leader Determined Membership protocol and Virtual Determinizer Framework. Low latency messaging protocol is used to deliver the message from the primary replica to the backup replica. Leader Determined Membership Protocol, when the primary replica becomes faulty the fast reconfiguration and recovery service based on the precedence and the rank in the backup replica. Virtual Determinizer Framework, it captures the ordering information from the primary replica and ensure that the backup replica gets the same order as the primary gets [20][21].

Zhou et al. [23] proposed a redundant VM placement optimization approach to minimizing the consumption of network resources. The proposed approach was a three-step process with one algorithm for each of the steps, namely (1) host server selection, (2) optimal VM placement, and (3) recovery strategy decision. The first algorithm selects an appropriate set of VM-hosting servers from a potentially large set of candidate host servers based upon the network topology. The second algorithm determines an optimal strategy to place the primary and backup VMs on the selected host servers. Lastly, a heuristic was used to address the task-to-VM reassignment optimization problem, which is formulated as finding a maximum weight matching in bipartite graphs. It enhance the reliability of cloud services, but problem is not reduced for complex cloud.

II.PROPOSED WORK

In the proposed work the fault tolerance mechanism is achieved in two levels. In the first level, the cloud users stores their real time application in to the buffer. From the buffer, all the application are fed in to multiple virtual machine for processing. After processing all the application in the virtual machine, it gives to the acceptance test. The acceptance test verifies whether all the virtual machine produces correct logical output or not. Then, the acceptance test gives its results (pass or fail criteria) to the time checker. The time checker checks that all the virtual machine performs its operation within the limit or not. Here the fixed time limit is 5000Ms.If the virtual machine produces the result on time, it gives the result to the reliability assessor.

. The reliability assessors assess the reliability of the virtual machine by using the reliability assessor algorithm. The reliability assessor algorithm checks whether all the virtual machine are reliable or not. Initially all the virtual machine reliability is set as 100%. If the virtual machine gives its result on time, its reliability increases otherwise the reliability of the virtual machine decreases. After assessing all the virtual machine reliability in the reliability assessor it gives the result to the decision making. In the decision making algorithm it takes only the best reliable virtual machine among all the virtual machine. There is a minimum and maximum reliability level is fixed for all the VM's. If the virtual machine reliability exceeds the maximum reliability level its reliability increases and we consider that virtual machine as best reliable virtual machine.

Pseudo code for Reliability Assessment

Step 1: To find the reliability of VM

Step 2: Set the reliability Factor as 1

Step 3: Get the input configuration as Reliability factor =1, Minimum reliability = 0.4, Maximum reliability >=1

Step 4: If the node status pass then reliability isincreases.

Step 5: If the node status fails then reliability isdecreases.

Step 6: The node reliability is greater than maximum reliability level then the node will be assigned as highest reliability.

Step7: The node Reliability is lesser than theminimum reliability level then the node will be assigned as lowest reliability.

Step 8: The node which has maximum reliabilitylevel is taken as best reliable VM among all VM's.

And that virtual machines results is send to the second level fault tolerance. In the second level, the replication approach is followed. After we assess the best reliable virtual machine, its results are stored in the group of replica manner. Here we follow LLFT messaging protocol, leader determined membership protocol and the virtual determinizer framework. In the group we have one primary replica and others are secondary replicas. The LLFT messaging protocol ensures that the message given by the primary replica is acquired by all the secondary replica in the group. The leader determined membership protocol determines that if the primary replica becomes faulty in the group the fast recovery and reconfiguration takes place. The virtual determinizer frame work ensure that the ordering information in the primary replica is acquired by all the secondary replica. Thus we can achieve high availability of data through replications.

Pseudo code for second level fault tolerance

Step 1: Storing the best reliable VM's output.

Step 2: The LLFT messaging protocol provides ordering information from the Primary replica to the secondary replica. The replicated applications Interact with each other directly via group multi cast.

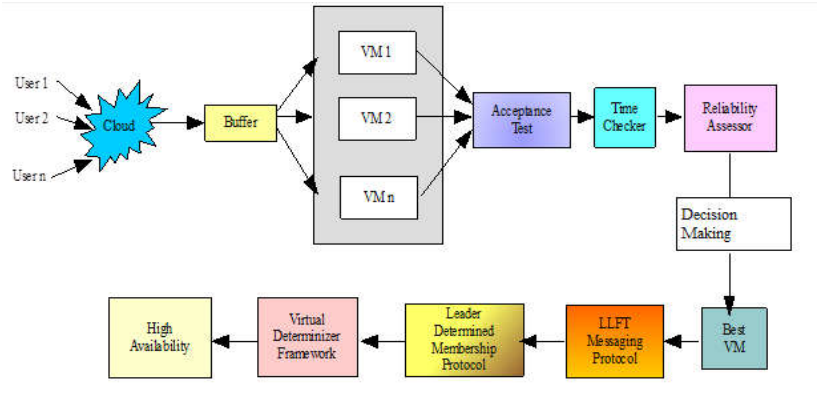

Fig. 1. Architecture of Multi level fault tolerance

Step 3: The Leader determined membership protocol takes necessary action when the primary replica fails. Among all the secondary backup replicas select one back upreplica as primary. This primary replica act as a original primary replica.

Step4: The virtual Determinizer frame work guarantees that all the secondary replicas in the group can obtain the same result as primary replica obtains.

Step 5: Thus we can obtain the high availability of data even when the primary replica fails.

III.SIMULATION AND ITS RESUTS

CREATING CLOUD ENVIRONMENT

The Multilevel fault tolerance method is implemented in Cloud sim tool. It provides infrastructure and services for modelling and simulation of cloud environment. By using cloudsim 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 Net beans IDE. Here all the VM starts their execution at a time.

TRADITIONAL DISTRIBUTED FAULT TOLERANCE AND ITS PERFORMANCE ANALYSIS

In this module the application are executed in the cloud environment in a traditional manner. Where all the applications are executed the reliability of the virtual machine is calculated and based on the analysis a performance graph is generated.

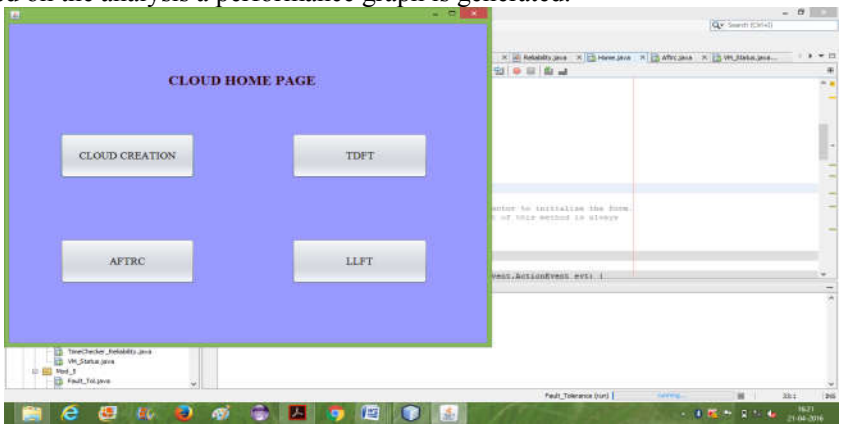

Fig. 2.Cloud Environment creation

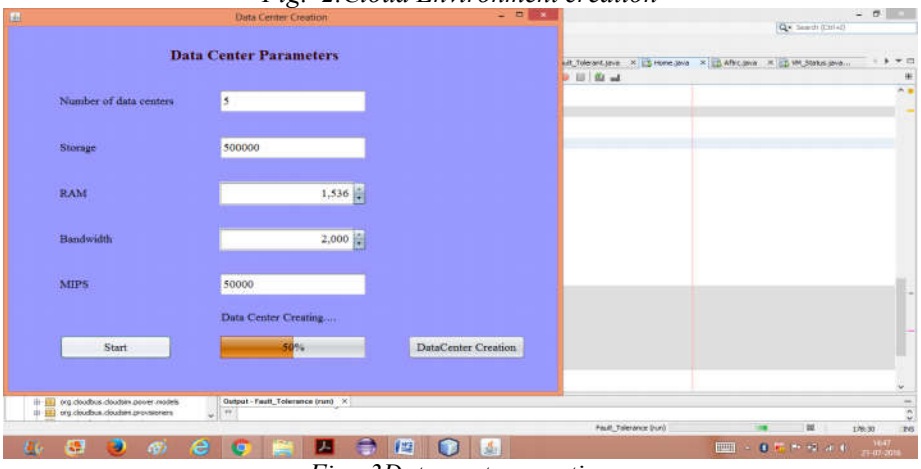

Fig. 3Data centre creation

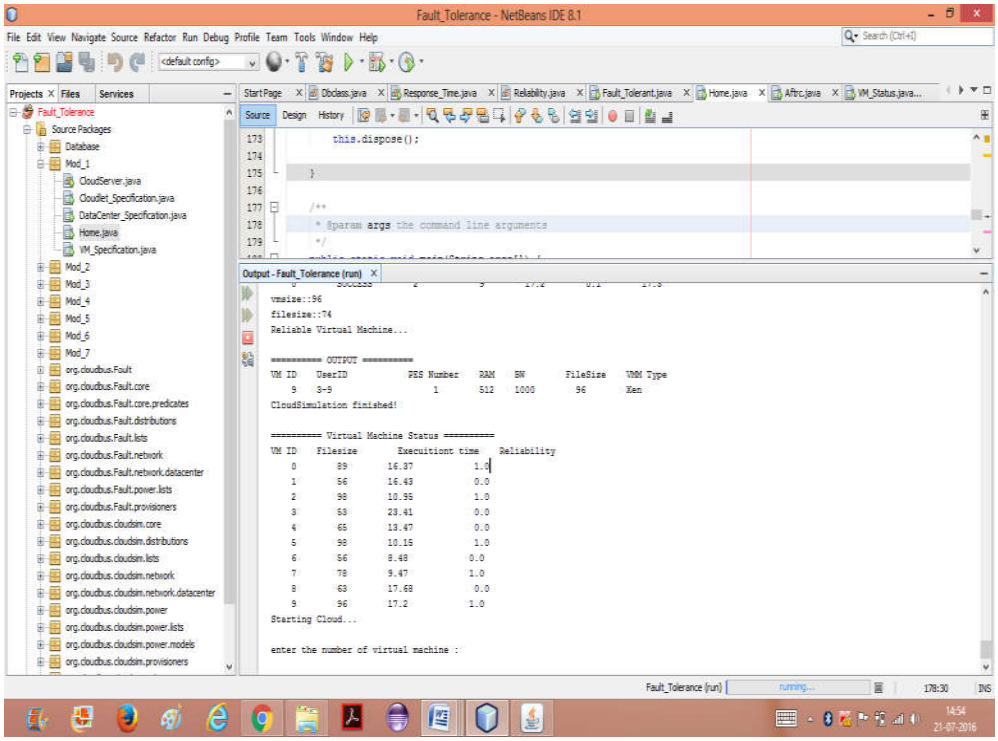

Fig. 4. Traditional distributed fault tolerance

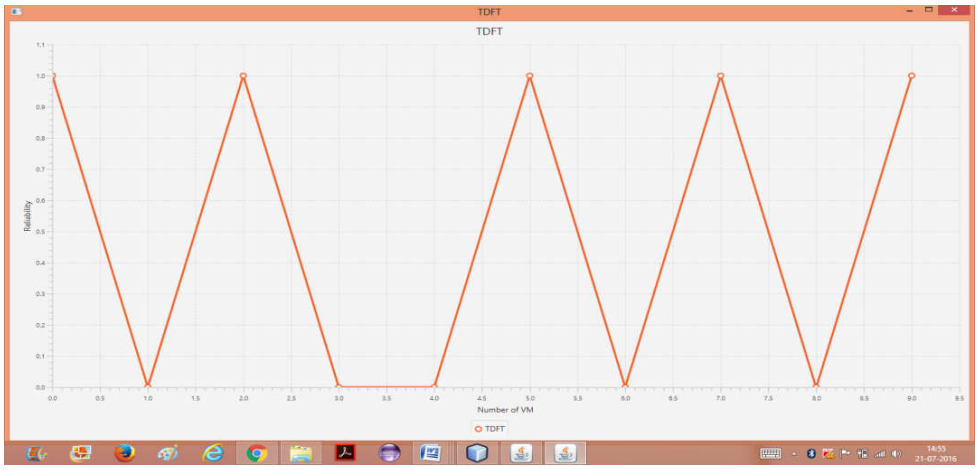

Fig. 5. Performance Analysis of Traditional distributed fault tolerance

FIRST LEVEL FAULT TOLERANCE (HIGH RELIABILITY)

In this module all the application are fed in to multiple virtual machine for processing it. Then with the help of reliability assessor we can classify the best reliable VM among all the VM's.

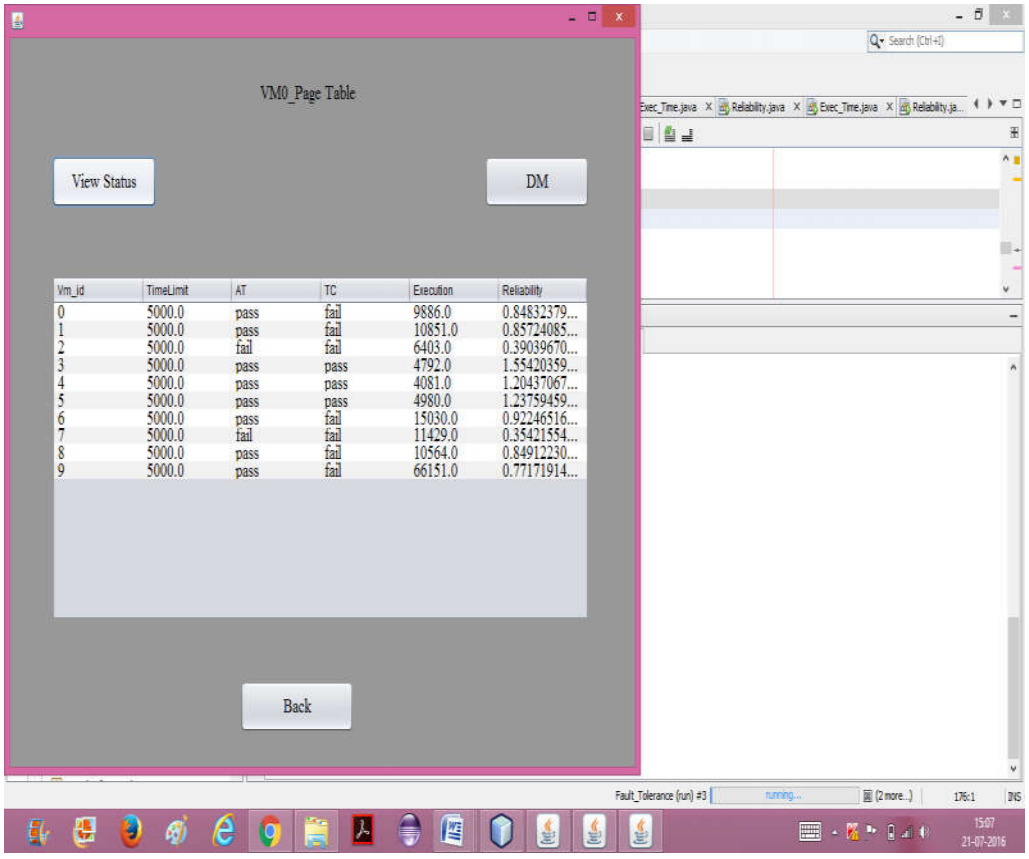

Fig. 6 Time checker and reliability calculation

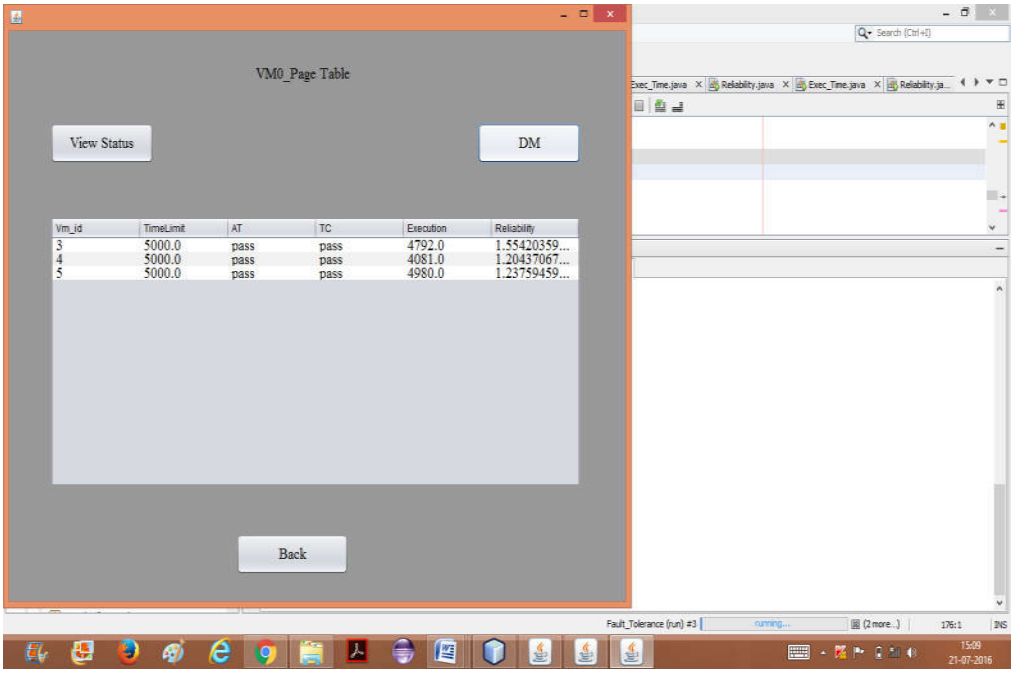

Fig. 7. Best Reliable Virtual Machine

SECOND LEVEL FAULT TOLERANCE

In this all the best reliable VM's output are given to the server to maintain the replication of data. If the client sends an request to the server to access the best reliable VM's data they can access the data. If suppose the server crash takes place, we can have the access to the same virtual machines data with the help of replication.

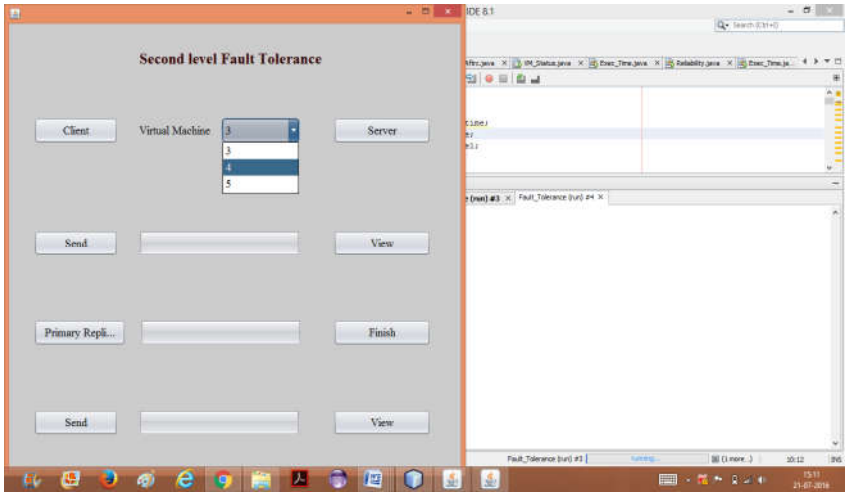

Fig. 8. Best VM output is stored in server and the data's are replicated

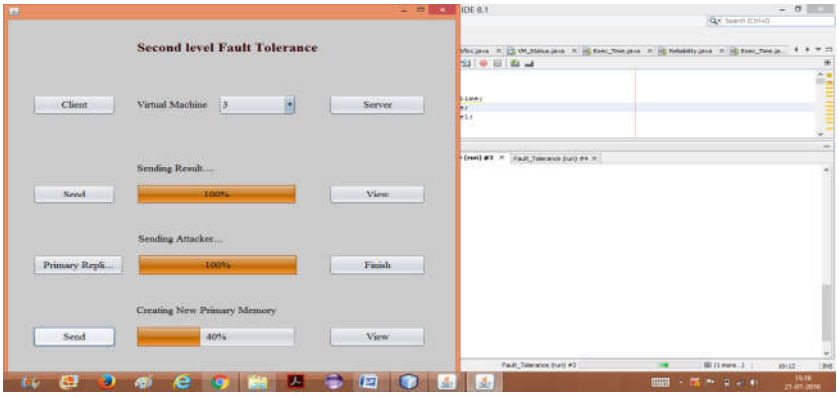

Fig. 9.Server Fault occurs

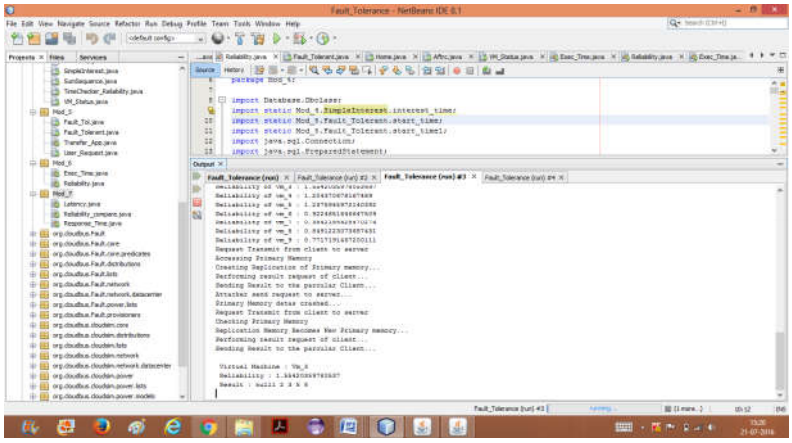

Fig. 10 Even if the server faults occurs we can acquire the VM's data from the replicated server

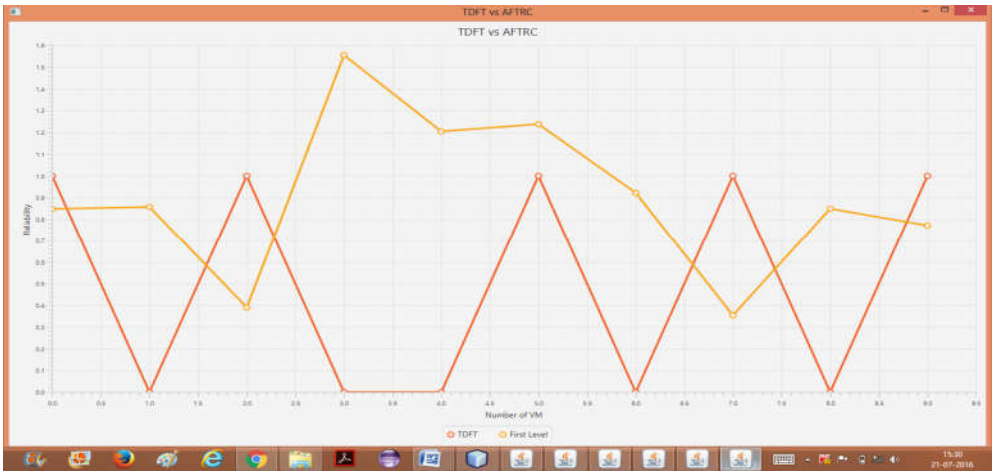

Fig 11 Reliability comparison of TDFT and First level fault tolerance

IV.CONCLUSION

Multi-level fault tolerance for real time application in cloud computing is shown by using cloud sim. Here the fault tolerance is achieved by two levels. In the first level, the best reliable VM is analysed to achieve high reliability. The best reliable VM output is given to second level of fault tolerance. In the second level the VM output is replicated among many replicas. Here it follows one primary replica and many secondary backup replicas. When the primary replica fails we get the data from the back up replica. The leader determined membership protocol allocates the secondary back up replica as the new primary replica when the original primary replica fails. Thus we can achieve the high availability of data even though the primary replica fails. So, with the help of multi level fault tolerance we can achieve high reliability and also high availability of data. And the comparison of traditional distributed fault tolerance is done against Multi- level fault tolerance and the analysis is performed. Based on the comparison the better reliability is achieved in the multilevel fault tolerance. This multi level fault tolerances achieves only 97 percentage of fault tolerance. In the future we can focussed to achieve 100 percentage of fault tolerance.

REFERENCES

[1] Amal Ganesh, Dr.M.Sandhya and Dr. Sharmila Sankar "A Study on Fault Tolerance Methods in cloud computing" 978-1-4799-2572-8/14/$31.00_c 2014 IEEE.

[2]http://www.tutorialspoint.com/cloud_computing/cloud_computing_tutorial.pdf

[3] N.Chandrakala and Dr.P.Sivaprakasam " Analysis of Fault Tolerance Approaches in Dynamic Cloud Computing"International Journal of Advanced Research in Computer Science and Software Engg 3(2), February - 2013, pp. 84-92

[4] Dr.Lakshmi Prasad Saikia and Yumnam Langlen Devi "Fault Tolerance Techniques and Algorithms in cloud computing" Dr.Lakshmi Prasad Saikia et al , International Journal of Computer Science & Communication Networks,Vol 4(1),01-08.ISSN:2249-5789

[5] Alain Tchana, Laurent Broto and Daniel Hagimomt "Fault Tolerant Approaches in Cloud Computing Infrastructures"ICAS 2012 : The Eighth International Conference on Autonomic and Autonomous Systems. ISBN: 978-1-61208-187-8

[6] Princy Gupta and Sugandha Banga "Topic- Review of Cloud Computing in Fault Tolerant Environment with Efficient Energy Consumption" IJSRM volume 1 Issue 4, July 2013 [www.ijsrm.in]

[7] Zeeshan Amin, Nisha Sethi and Harshpreet singh "Review on Fault Tolerance Techniques in cloud Computing " International Journal of Computer Applications (0975 – 8887) Volume 116 – No. 18, April 2015.

[8] Jasbir Kaur and Supriya Kinger "Analysis of Different Techniques Used For Fault Tolerance" Jasbir Kaur et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (3) , 2014, 4086-4090.

[9] Seyyed Mansur Hosseini and Mostafa Ghobaei Arani "Fault-Tolerance Techniques in Cloud Storage: A Survey" International Journal of Database Theory and Application Vol.8, No.4(2015),pp.183-190

[10] Sheheryar Malik,and Fabrice Huet "Adaptive Fault Tolerance in Real Time CloudComputing" 2011 IEEE World Congress on Services
[11] Jayadivy.SK, Jayanirrmala.S, Mary Saira Bhanus "Fault Tolerance Workflow Resubmission of Tasks in Cloud Computing" (IJCSE)
[12] AnjuBaland InderveerChana "Intelligent failure prediction models for scientific workflows" A. Bala, I. Chana / Expert Systems with Applications 42 (2015) 980–989
[13] G. Vallee, K. Charoenpornwattana, C. Engelmann, A. Tikotekar and S. L. Scott, "A Framework for Proactive Fault Tolerance
[14] JasbirKaur and SupriyaKinger "Efficient Algorithm for Fault Tolerance in CloudComputing" JasbirKaur et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (5) , 2014, 6278-6281.
[15] Dhananjaya Gupta, AnjuBala "Autonomic Fault Tolerant Framework for Web Applications" IJCST Vol. 4, Issue 2, April - June 2013
[16] L. Wu,, B. Liu, and W. Lin. "A Dynamic Data Fault-Tolerance Mechanism for Cloud Storage." In Emerging Intelligent Data and Web Technologies (EIDWT), 2013 4th International Conference on, pp. 95-99. IEEE, 2013
[17] A.Tchana, L. Broto, and D. Hagimont."Approaches to cloud computing fault tolerance."In Computer, Information and Telecommunication Systems (CITS), 2012 International Conference on, pp. 1-6.IEEE, 2012.
[18] P.Das and P.M Khilar "VFT: A virtualization and Fault Tolerance approach for cloud computing" Information and communication Technologies (ICT), 2013 IEEE Conference.
[19] Y. Zhang, Z. Zheng, and M. R. Lyu. "BFT Cloud: A byzantine fault tolerance framework for voluntary-resource cloud computing." In Cloud Computing (CLOUD), 2011 IEEE International Conference on, pp. 444-451. IEEE, 2011
[20] Wenbing Zhao, P.M.Melliar-Smith and L.E.Moser "Low Latency Fault Tolerance System" T*he Computer Journal*.Volume 56 Issue 6, June 2013
[21] Wenbing Zhao, P.M.Melliar-Smith and L.E.Moser "Fault Tolerance Middle ware for Cloud computing" 2010 IEEE 3rd International Conference on Cloud Computing 978-0-7695-4130-3/10 $26.00 © 2010 IEEE DOI 10.1109/CLOUD.2010.26
22. Mukwevho, Mukosi Abraham, and Turgay Celik. "Toward a Smart Cloud: A Review of Fault-tolerance Methods in Cloud Systems." IEEE Transactions on Services Computing (2018).
23.Zhou A, Wang S, Cheng B, Zheng Z, Yang F, Chang RN, Lyu MR, Buyya R. Cloud service reliability enhancement via virtual machine placement optimization. IEEE Transactions on Services Computing. 2017 Nov 1;10(6):902-13.
24.Mohammed B, Kiran M, Maiyama KM, Kamala MM, Awan IU. Failover strategy for fault tolerancein cloud computing environment. Software: Practice and Experience. 2017 Sep;47(9):1243-74