RESEARCH ARTICLE OPEN ACCESS

Review Of Fault Tolerance Strategies Use Within Cloud Computing

Rupinder Kaur [1], Malkit Singh [2]
Student [1], Assistant Professor [2]
Department of Computer Science and Engineering
Golden College of Engineering & Technology
Gurdaspur- India

ABSTRACT

The technology is enhancing day by day. This technology allows users to utilize resources beyond the capacity of the machines they are using. Cloud is one such technology permitting the users to achieve the same. Cloud computing provide physical machines on which multiple virtual machines are supposed to execute. This helps in reducing the need of physical machine in computation environment. As the dependency on the virtual machines increases, the risk factor such as threat to integrity also increases. Any interruption or comprise in this area of virtualization may cause dire consequences. This problem is aggravated in a situation where virtualized data centres are deployed. Fault tolerant capabilities hence are critical in virtual data centers or virtualization. The prime objective of proposed work is to analyse distinct fault tolerant capabilities utilized in virtualization and provide comprehensive comparison of techniques to determine optimal methods.

***Keywords:*—**Resources, Cloud Computing, Physical Machine, Virtualization, Fault tolerance capabilities

I. INTRODUCTION

Today dependency on virtual data centre for computation is increased beyond expected levels. The users can be of distinct categories. The threat to enterprise can adversely affect its performance and operation. The problem is independent of operating system on distinct physical machines. The fault tolerant capabilities hence have to be different to tackle various hazards. This section describes potential hazards and risks that can affect the performance of data centers providing virtual environment. The second section describes various techniques associated with Fault tolerance in VM migration. The third section presents comprehensive comparison between techniques by highlighting pros and cons. Last section presents conclusion indicating optimal strategy.

A. *Software Crashes*

F This type of failure is omnipresent. It is common on physical as well as virtualized environment. The operating system present on virtual machine can crashes due to bugs in kernel causing temporary loss of server. This degrades performance of virtual as well as physical machine. Applications running on the virtual and physical machine can also abruptly terminate. Such events cause the server to be down indefinitely.

B. *Updating Software*

Every virtual machine has to be periodically upgraded which includes security fixes, bug fixes etc. During the up gradation both machines are down. This enhances the downtime of virtual as well as physical machines. This also appears within the hazards which degrade the performance of virtualization.

C. *Start Up failure*

This type of failure occurs when VM is migrated to older server. Migration not always assures flawless reliability. Insufficient and inappropriate resources cause the VM to fail immediately. Resources need to be shared and data is needed to be migrated to safe locations provided with the help of fault tolerant capabilities.

D. *Incompatible server hardware*

At application level migration, compatibility is necessary. Compatibility is generally defined in terms of hardware. During migration process if hardware is not compatible then application fails to execute. So during migration hardware compatibility needs to be considered.

E. *Conflicting VM task*

T Program when executes process formulates. Process run either in front or back end. The process sometimes continues to execute on the server even after finished execution. Such processes are known as daemon processes. In the presence of daemon process if some other process appears and tries to execute then server error appears. These problems are tackled by handling processes through the techniques of concurrency control.

These are some performance degradation mechanisms owing to fault tolerant capabilities.

II. FAULT TOLERANT MECHANIMS AS PART OF VM MIGRATION

There exists fault and failures during hardware and software migration processes. In order to tackle such situations Fault Tolerant mechanism are critical. Techniques for achieving it are discussed in this section.

A. FAULT TOLRANCE THROUGH RAPLICATION

This is a common approach for implementing fault tolerant capability using primary and secondary backup system. The secondary backup is always present if the primary server fails. The state of the secondary server should be same as the primary server. The implementation of backup server is accomplished with the help of VMware. The model which is followed is listed as

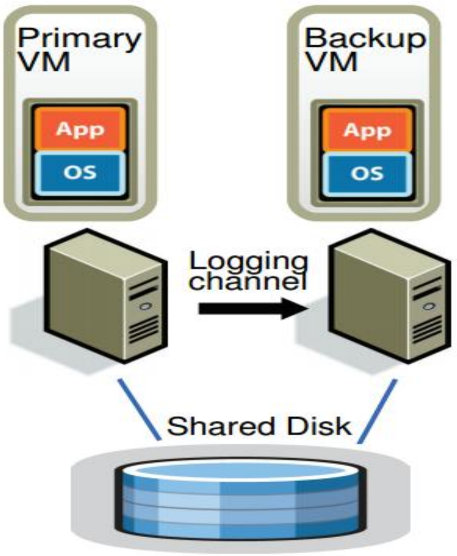

Fig 1: Model for Backup server

The redundant array of independent disks along with parity check mechanism can also rectify faults also. The replication and parity check mechanism enhance the performance of server. The data in case of failure is recovered through RAID along with parity check mechanism. Parity can be even or odd. The even parity has even number of 1s in the data. The odd parity has odd number of 1s. In case of problem the parity within the data altered and problem can be detected. (1)

B. FAULT TOLERANCE THROUGH TRANSPARENT VM LEVEL MIGRATION

E Virtual cluster supra system is considered in this case. The virtual cluster consist of virtual machines along with multitude of software components which doomed to be failed eventually. Fault tolerant capabilities are required to be implemented in this case. The virtual cluster enhances availability, reliability and manageability. It coordinates the distributed VMs to reach the stable and consistent state. When fault occur virtual cluster automatically recovers the state of the VMs to consistent state. The save point and checkpoint is utilized in this case. The model utilized in transparent VM level migration is shown through the following diagram

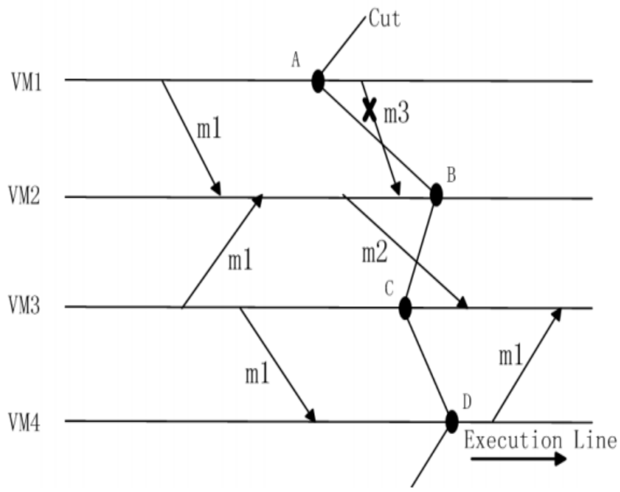

Fig 2: Showing Transparent VM level Migration (2)

C. Survival Control Plane Strategy

This mechanism ensures backup to be taken in elastic optical network. Since network is utilized which is prone to failures hence entire process of elastic network is at stakes. In order to resolve the problem novel mutual backup model is proposed in the studied paper. The integer linear programming model is then created to solve survival control plane problem. In the earlier scheme of things wavelength division multiplexing techniques are utilized. Number of output lines required to transfer and back up is reduced by the use of WDM. The problem of slow migration appears in this case. in order to resolve the problem optical medium is suggested. The optical medium transfer the data at the speed of light hence overall transfer rate enhances. More data can be transferred hence throughput is also enhanced. (3)

D. Burstiness Aware Resource Allocation

T The burstiness occurs aperiodically in migration. The spikes occur variantly and for short interval in cloud. VMs are consolidated by minimum number of physical machines utilized. To meet the dynamic demands of VMs in PMs some of the Vms has to be migrated to other PMs. Certain amount of resources are preserved in PMs to avoid unnecessary migration is proposed through BARA. Queue is maintained to store spare resources. These resources are exposed to VMs as and when required to reduce the work load and overhead associated with migration. (4)

E. Virtualization for fault tolerance

The virtualization mechanism can be utilized in order to introduce fault tolerance capabilities. Virtualization is accomplished by the use of Hadoop. This software allow migration of resource from single physical machine to multiple physical machines. The reliability of resource migration is always at stakes since failure during the migration process result in loss of vital information. The fault tolerance scheme utilized in this case is known as

Virtualized fault tolerant technique. This fault tolerant capability is implemented at IaaS of the cloud. (5)

F. Migration based on Time Cost Modelling

Live VM migration strategies have to be created to enhance performance of servers on which migration is performed. The migration requires resources to be consumed along with cost to be encountered. The cost results from overhead and migration time is the prime source of this cost. In order to resolve this issue migration time is reduced hence migration overhead along with cost is reduced. VM migration with this model is efficient enough to handle faults during migration. Using this model averaging migration accuracy is 90%. So this technique is better as compared to other strategies described in previous sections.(6)

G. Fault tolerance and Migration through Proactive approach

Data in repository is critical and not required to be extirpated. This causes size of repository to grow beyond limits surges to Migration. In a tainted backdrop risk of losing data is always extant. Fault tolerant capabilities are mandatory in such situations. The objective of this paper is to analyze such fault tolerant capabilities in Migration to enhance performance and making users non apprehensive. The resource allocation strategy which is followed in migration is proactive in nature. It means that resources allocated to the VMs are not fixed. In the beginning resources are allocated statically. The VMs progress is noted and if VM goes down or migrated then resource is prompted hence resource allocated to VM is not wasted. Typical workload on individual VMs is of prime concern through which offloading is suggested in this case. Enhanced throughput and better result is obtained in this case. (7)

H. Fault tolerance using Metric like Downtime and Migration time

T More the downtime less will be the performance. The concern of this paper is to develop a strategy which can be used to enhance the performance and obtained optimal performance by the use of bandwidth limiting factor to reduce downtime and migration time. Creating a tradeoff between the strategies is need of the hour. This trade off indicates that both metrics are inversely proportional to each other. If downtime is more than migration time is less and vice versa. This approach introduces delay within migration so that sufficient amount of time is present in order to perform back operation in order to enhance fault tolerance mechanism. In case of failure recovery can be performed from the backing store. So this could lead to performance degradation. In this approach bandwidth requirements are calculated to determine overhead to be encountered to obtained optimal result. (8)

TABLE I. COMPARISON OF TECHNIQUES UTILIZED IN CLOUD COMPUTING

Authors and Title	**Year**	**Journal**	**Technique**	**Downtime**	**Migration Time**	**Cost**	**Energy Consumed=P*t/1000**	**Fault Tolerant**	**Bytes Transferred**
(9) William Voorsluys and others, 'Cost of Virtual Machine Live Migration in Clouds : A Performance Evaluation', 254–65.	2009	Springer	Cost Evaluation in VM Migration	3 Sec	Home Page Loading 0.32 Sec Adding New Person 2.28 Sec	Cost Encountered is high for 600 Concurrent users	0.9*1.09/1000=0.0009J	Fault Tolerant Capabilities are absent and hence Service layer Applications are violated	Maximum 2GB
(10) Daeyong Jung and others, 'VM Migration for Fault Tolerance in Spot Instance Based Cloud Computing', 2013, 142–51.	2013	Springer	Spot Instance Based	downtime in terms of recovery 300s	300s	Minimum cost 0.005$ and Maximum 1.122$	20*300/1000=6J	Checkpoint Based Technique	High Memory to Low Memory Utilization Variation
(11) Bangjie Jiang and others, 'Priority-Based Live Migration of Virtual Machine', 2013, 376–85.	2013	Springer	Priority Based	600 ms for high priority	600ms	Migration time is reduced by 5.5 % hence cost is also reduced	Power calculation mechanism is not specified	This capability is not utilized	Maximum 8GB
(12) Israfil Biswas and others, 'An Analysis of Live Migration in Openstack Using High Speed Optical Network', 2016, 1267–72.	2016	IEEE	OpenStack	Minimum 0.3s and maximum 0.7s	Minimum 11.2 s and Maximum 12 s	Zero Length Encoding is used to reduce Cost	Power calculation mechanism is not specified	Not utilized	Maximum 15.04 LTS
(13) Haikun Liu, Hai Jin and Cheng-zhong Xu Xiaofei, 'Performance and Energy Modeling for Live Migration of Virtual Machines', 2013, 249–64 <http://dx.doi.or	2013	IEEE	Performance modelling	Maximum 1200 ms and minimum 23ms	60s	Cost is minimized as Energy Consumption is 300Joules	420*60/1000=25.2 for peak processors	Not Defined	1GB

g/10.1007/s10586-011-0194-3>.									
(14) Fei Ma, Feng Liu and Zhen Liu, 'Live Virtual Machine Migration Based on Improved Pre-Copy Approach', 2010, 230–33.	2010	IEEE	Improved Pre copy	Minimum 10% and maximum 63%	Reduced by 32.5%	Cost is minimized since downtime and Migration time are reduced	No mechanism for power calculation	Not defined	Maximum 1024MB Minimum 64MB
(15) Yanqing Ma and others, 'ME2 : Efficient Live Migration of Virtual Machine With Memory Exploration and Encoding', 2012, 2–5	2012	IEEE	Memory Exploration and Encoding	47.5% downtime is reduced	48.2% of migration time is reduced	Ignorable Cost	No mechanism for power calculation	Not Defined	50.5% of total data could be reduced
(16) 'Virtual Machine Migration Planning in Software-Defined Networks', 2015, 487–95.	2015	IEEE	Migration Technique which is software defined	20%Reduced	40%Reduced	Cost is reduced	No mechanism for power calculation	Not Defined	Minimum 203 GB Maximum 212 GB
(17) Umar Kalim and others, 'Seamless Migration of Virtual Machines Across Networks', 2013.	2013	IEEE	Protocol Based	Compatibility of protocols are checked	Compatibility of protocols are checked	Not defined	No mechanism for power calculation	Not Defined	Data transferred through use of TCP/IP protocol
(18) Ganesan Radhakrishnan, 'Adaptive Application Scaling for Improving Fault-Tolerance and Availability in the Cloud', 17.2 (2012), 5–14	2012	IEEE	Adaptive Scaling	Downtime is not considered	Migration Time is not considered	Not Defined	No mechanism for power calculation	Adaptive Scaling to enhance fault tolerant	Not Specified
(19) Andreas Pamboris and Peter Pietzuch, 'C-RAM : Breaking Mobile Device Memory Barriers Using the Cloud', 1233.c (2015), 1–14	2015	IEEE	Memory Based	9.7% Faster	9.7% Faster	Not Specified	0.5*9.7/10000=0.000485	Snapshot Based	Minimum 150MB Maximum 800MB

(20) A System-level Perspective and others, 'Fault Tolerance Management in Cloud Computing ':, 2012, 1–10.	2013	IEEE	System Level Fault Tolerant Mechanism	Not Specified	Not Specified	Not Specified	No mechanism for power calculation	System Level fault Tolerance	Quantity of data is not considered
(21) Michael Menzel and others, 'CloudGenius : A Hybrid Decision Support Method for Automating the Migration of Web Application Clusters to Public Clouds', 6.1 (2014)	2014	IEEE	CloudGenius wit genetic algorithm	Enhanced Speed to reduce downtime	Reduced Migration time	Reduced cost	No mechanism for power calculation	Not Considered	Heterogeneous cluster is considered

The comparison is comprehensive and suggest techniques utilizes enhanced features however collaborative approach is ignored in which fault tolerant capabilities are not hybridized with VM Migration. The proceeding section describes pros and cons of techniques evaluated in comparison table which accordingly considered optimal.

III. PROS AND CONS OF TECHNIQUES ASSOCIATED WITH CLOUD

Pros describe favourable factors and con the unfavourable one. In this section description of each is presented comprehensively.

IV. COST EVALUATION IN CLOUD

The cost evaluation gives overhead associated with migration. The prime focus of this technique is to minimize the cost associated with migration so does migration and downtime. (22)

A. Pros

- F Cost is considered which is building block of all other factors
- Minimization Strategies are considered to reduce both cost and amount of data to be migrated

B. Cons

- T Fault Tolerant strategy is not considered.
- Risk of loss of data is always present

V. SPOT INSTANCE BASED STRATEGY

The fault tolerance strategy is specified in the considered approach. Checkpoint based approach is considered.(23)

A. Pros

- Fault Tolerant Strategies are considered
- Recovery in case of failure is possible

B. Cons

- Less Stress is on downtime and Migration time
- Cost is not optimal

VI. PROACTIVE APPROACH

Adaptive scaling based approach is also termed as proactive approach.

A. Pros

- Fault tolerance along with migration is considered.
- Migration process is clean because of tolerance capabilities.

B. Cons

- L Migration time is not considered
- Migration Cost is not Considered

VII. MEMORY EXPLORATION BASED

The memory exploration is discovery of necessity. The utilization of memory resources is reduced by the considered approach

A. Pros

- F Data to be transferred is reduced
- Downtime is significantly reduced
- Migration time and cost is reduced

B. Cons

- Fault tolerant capabilities are not considered.

VIII. GENETIC ALGORITHIM

This algorithm is utilized in almost every area of technology. The genetic algorithm is replacing iterative approach to problem solving.

A. Pros

- F Downtime is reduced
- Migration time and cost is reduced

B. Cons

- Fault Tolerant capabilities are not considered.

The pros and cons indicate the considered approach does not collaborate to form hybrid approach. The performance of existing techniques hence is limited to particular scope only. The performance can be enhanced by forming strategy to collaborate multiple techniques by taking pros of techniques to enhance performance of existing algorithms.

IX. CONCLUSION AND FUTURE SCOPE

The performance of existing algorithm is comprehensively described in this work. The comparison between techniques suggests need for state of the art algorithm for enhancing VM migration along with fault tolerance capabilities which is yet deprived. The adaptive scaling and memory exploration techniques are considered to be optimal in their class with reduced complexity but without cost parameter associated with them. The migration time and downtime in these strategies are also not optimal.

In future better features of both techniques can be utilized along with fault tolerant capabilities like checkpoint to create state of the art enhanced performance algorithm.

REFERENCES

[1] htps://developer.cisco.com/fileMedia/download/c2cff0ed-ff2c-4918-8133-913d202d7e26

[2] Zhang M, Jin H, Shi X, Wu S. VirtCFT : A Transparent VM-Level Fault-Tolerant System for Virtual Clusters. 2010;147–54.

[3] Zhao B, Chen X, Zhu J, Zhu Z. Survivable Control Plane Establishment With Live Control Service Backup and Migration in SD-EONs. 2016;8(6):371–81

[4] Zhang S, Qian Z, Luo Z, Wu J, Lu S. Burstiness-Aware Resource Reservation for Server Consolidation in Computing Clouds. 2015;9219(c):1–14.

[5] Liu CYJ, Chou CHW. On improvement of cloud virtual machine availability with virtualization fault tolerance mechanism. 2013;

[6] Li Z. Optimizing VM Live Migration Strategy Based On Migration Time Cost Modeling. 2016;99–109.

[7] Wolke A, Bichler M, Setzer T. Planning vs . dynamic control : Resource allocation in corporate clouds. 2014;7161(c):1–14.

[8] Zhang J, Ren F, Shu R, Huang T, Liu Y. Guaranteeing Delay of Live Virtual Machine Migration by Determining and Provisioning Appropriate Bandwidth. 2015;9340(c).

[9] Voorsluys W, Broberg J, Venugopal S, Buyya R. Cost of Virtual Machine Live Migration in Clouds : A Performance Evaluation. :254–65.

[10] Jung D, Chin S, Chung KS, Yu H. VM Migration for Fault Tolerance in Spot Instance Based Cloud Computing. 2013;142–51.

[11] Jiang B, Wu J, Zhu X, Hu D. Priority-Based Live Migration of Virtual Machine. 2013;376–85.

[12] Biswas I, Parr G, Mcclean S, Morrow P, Scotney B. An Analysis of Live Migration in Openstack Using High Speed Optical Network. 2016;1267–72.

[13] Liu H, Jin H, Xiaofei CX. Performance and energy modeling for live migration of virtual machines. 2013;249–64.

[14] Ma F, Liu F, Liu Z. Live Virtual Machine Migration based on Improved Pre-copy Approach. 2010;230–3.

[15] Ma Y, Wang H, Dong J, Cheng S. ME2 : Efficient Live Migration of Virtual Machine With Memory Exploration and Encoding. 2012;2–5.

[16] M Virtual Machine Migration Planning in Software-Defined Networks. 2015;487–95.

[17] Kalim U, Gardner MK, Brown EJ, Feng W. Seamless Migration of Virtual Machines Across Networks. 2013;

[18] Radhakrishnan G. Adaptive Application Scaling for Improving Fault-Tolerance and Availability in the Cloud. 2012;17(2):5–14.

[19] Pamboris A, Pietzuch P. C-RAM : Breaking Mobile Device Memory Barriers Using the Cloud. 2015;1233(c):1–14.

[20] Perspective AS, Jhawar R, Member GS, Piuri V. Fault Tolerance Management in Cloud Computing : 2012;1–10.

[21] Menzel M, Ranjan R, Wang L, Member S. CloudGenius : A Hybrid Decision Support Method for Automating the Migration of Web Application Clusters to Public Clouds. 2014;6(1).

[22] Wu Q, Ishikawa F, Zhu Q, Xia Y, Member S. Energy and migration cost-aware dynamic virtual machine consolidation in heterogeneous cloud datacenters. 2016;1374(c).

[23] Yi S, Andrzejak A, Kondo D. Monetary Cost-Aware Checkpointing and Migration on Amazon Cloud Spot Instances. 2012;5(4):512–24.