Virtualization: A Solution for High Availability

Mukesh Chandra Negi[1,*] and Dr. D.K. Pandey[2]
[1,*]Research Scholar, Department of Computer Science, JJTU, Rajasthan
[2]Director, Dr. Pandey Professional College, Ghaziabad

*Virtualization is a technique where a physical server can be divided into multiple virtual servers and each server has its own resources like RAM, CPU, Disk Storage etc. initially the concept of virtualization was initiated specific in the terms of Hardware but later it has got great success in term of Software's also. There are lots of benefits of hardware as well software virtualization specifically in the field of information technology. Such benefits are like cost saving in terms of infrastructure cost, Labor cost, Hardware cost, Software cost, Space cost, Failover capabilities in case of hardware as well as software failure, reduced the downtime of the production application and most importantly its very helpful in case of any planned or unplanned outages. Since the applications running on production environment has demand the high availability to serve the client requests 24*7, so it's necessary to minimize the downtime of any planned or unplanned outages as well provide the failover capabilities to minimize the un planned outages. Virtualization is a perfect solution for such an environment where great high availability demanded although still few problems and limitations are there those need to rectify in the future to make it widely accepted by all of the organizations specifically in term of Information Technology. Few of the current issues are like there is no proper way to know the failure of the primary machine because the synch between primary and secondary backup machine can be break due to n number of reasons like due to some network latency or missing of heartbeats due to certain reasons etc. sometimes secondary backup machine did not able to recognize the failure of primary machine due to partial services failure and failover concept didn't work properly. Apart from that in case of outage of a particular shared resource like shared drive between n numbers of virtual machines impacted the functionality of all of the machines. Still lots of research works have been going on in the same to find out a pure error free virtualization platform.*

Keywords: Availability, Virtualization, Load balancing, Failover, Recovery, Outages, Cluster.

1. INTRODUCTION

Availability always have been the most critical challenging and majorly focused area in every field in the world whether it's Information technology, Banking, Railway, Aviation, Health, Transportation, Food Industry, Manufacturing or any business which is directly related with service, contract, service level agreement and wealth. Since it's directly related with the revenue and money so today every related organization spending lots of time and money in this field to get high availability for their respective environment [1,2].

Today lot's of options are available in the world to achieve high availability for each and every respective technology and organization, for example in a small printing press there is always a backup of the printing machine so that in case of failure of primary machine work can done from the secondary machine which also call be the disaster recovery or failover machine. But yes it's a costly way to achieve high availability because for that you need a second machine which will cause the same cost as of primary machine but this will give you a trust that in case of any issues with the primary machine, work and revenue related with the ordered consignment will not impact.

In the same way you can consider the case of banking sector, today banks are operating their operations in e-way and trying to attract the customers by providing lots of e-facilities like online transfer, draft issue, statement etc and their business is directly related with the highly available 24*7 running systems so that the customers can take the e-facilities any time 24*7. So the business directly related with customers and the customers are directly related with the availability of the bank services because before opening an account a customer always check the services provided by the banks and most important factor how frequently the services are available. If you will see or will get feedback that some back services are very slow or the online websites didn't respond timely and on expected time then you will not go to open account in that bank So this is the loss of that particular bank due to the low available services [3,4].

Now we understand the value of high availability, organizations since decades have been doing research in the field of virtualization and the major leaders in the market those providing the virtualization solutions are Oracle, Sun (Now part of Oracle) and IBM. Virtualization can be divided into different categories like Hardware virtualization which can further categorized as Full, Partial and Para virtualization, , Resources virtualization like of Memory, Storage, CPU etc, Network virtualization where we create virtual network addressing space within same or across different subnets and Desktop virtualization which is based on the concept of client server architecture where n number of desktops are connected with a centralized machine having same hardware and software resources, modernly you can say it as an example of cloud computing [5,6].

1.1. High Availability and Virtualization

We can divide the term "High availability using virtualization" in three different terms, high, availability and virtualization. Availability is as we have explained in our all previous statements and High Availability is just the consideration for how long your system is running, if some system is running but with an outage rate of 30 to 40 % then we can say it's available but we can't say its highly available, on the other side if a particular system is running almost continuously with an outage rate of 1 to 5 % then we can say that system as highly available.

Virtualization concept will dramatically reduce the time to create a highly available environment, the cost of the system, space required for the setup, better utilization of the existing resources, reduce the labor cost and much more [6].

Specific in IT industry, outages can be divided into different categories like:

(a) Planned.

(b) Unplanned.

And each outage can be due to any of the below factor:

(i) Software (Application).
(ii) Hardware (Machines and operating systems).

A planned outage which is pre planned and decided by the management on specific day and time, in that case during of planned outage applications are failover to the secondary available environment to continue the business activity.

An unplanned outage which is not pre planned and caused by due to failover of either hardware or software. This directly related with the ETA (estimated recovery time) and financial implications to the organization according to the service level agreement signed with the customer.

There is a connection between outages type and the cause of outages like planned outages can be due to Software or Hardware or unplanned outages can be due to Software or Hardware failure.

Lots of hardware and software were introduced in the field of computing like hardware load balancers, software load balancers like web servers, clustering which is the group of multiple applications work together with same functionality etc but virtualization is the term specifically designed to explore the capabilities of your hardware resources like the processor, RAM, buses, cpu utilization, cache etc. [7].

1.2. Cluster, Load balancing and Failover

Cluster concept was introduced in conjunction with hardware as well as with Software. In case of specifically to the hardware, different machines are clustered together to provide the failover as well as load balancing. So that in case of failure of any one machine, other machines in the cluster will continue to work to provide the high availability and further the services can be migrated to the other machine in case of interruption of the services in the mid of certain request. But the drawback is same that this setup is very costly because you need a replica of each and every machine to work in conjunction with the other machines. Second you need more labor, more space, more hardware, and more maintenance which is directly in proportion to the cost to organization [8,9,10].

Specifically in case of Software, Clustering has been implemented by implementing the parallel logical division of servers called managed servers where the same application distributed equally and work together to provide the failover and load balancing capabilities. Suppose we have a group of four managed servers and we have distributed an application to all managed servers so that in case of failure of any one of the managed server other three will serve the request and in the same way in case of failure of other managed server other servers in the cluster will serve the request. Same concept will be applicable in the case of failure of a particular instance in between serving the requests [11].

Cluster load balancing work on the certain defined manners or you can say algorithms like:

1) Round Robin.
2) Random.
3) Weightage based.

Round robin cluster load balancing worked in cyclic manner. Suppose if we have two servers in the cluster then first request will forward to first managed server and second request will forward to second managed server and the third one will cyclic again to the first managed server. This topology should be taken care at the time of the cluster configuration.

Random cluster load balancing doesn't works on any login, it just forward the request to any one of the managed server in the cluster. Suppose if we have two managed servers in the cluster then the request will forward to any of the managed server, may be first two request on first managed server or one to first server and other to second managed server or both requests to second server [12,13,14].

Weightage cluster load balancing work on the basis of the weightage defined for each and every server in the cluster. It's useful in case we have some machines with low configuration and some with high configuration, in that case we know a server with good configuration can able to handle large number of requests in comparison with the server with low configuration. We defined the percentage of load for each and every server during cluster configuration like suppose we have two machines having first machine with good hardware resources and second one with low hardware resources then we can define the algorithm like 80% of load goes to first machine and only 20% of requests should goes to second machine.

2. EARLIER PROBLEMS AND REQUIREMENTS WITH VIRTUALIZATION

High availability using virtualization is the key component for each and every organization having the IT infrastructure either on large scale or small scale. Companies in major have been started accepted virtualization as a standard solution for their business applications to provide the reliable continuity solution but still some uncertainties are there regarding the implementation and testing of the virtualization solution. To alleviate continuity of business using virtualization environment is a challenge. We believe lots more organizations and companies should need to accept and implement virtualization machines, storage for high availability, disaster recovery solutions, business continuity and for operations need. Organizations should give a deep thought and considerations on whether they really want to adopt a virtualized technology and to implement a rule and strategy to enable them to take advantages of virtualized shared storage, better server utilization, minimize downtime, reduce business and financial risks in case of disaster and increase the availability of their operational environments [16,17,18].

It has not been popular few years back just like it's widely accepted recently by mostly all the organizations. Here are the main problems on the way to this technology:

1) Hardware performance was very low.

2) The tool to manage virtualization was not so simple and powerful.
3) There were no O.S. support.
4) Reliability was very low of the virtualization software.
5) Organization were had no faith on untried technology.
6) No more updates from the companies providing the technology.

Virtualization offered a new way to upgrade the IT infrastructure in a new technological and flexible way. You can build independent machines those can work together as well as independent with and without tie up with a physical machine [19].

So the prerequisites for an organization before virtualization of the systems are:

1) Average load of production servers are low.
2) There are new specific hardware requirements.
3) Have to manage large number of computers.
4) Have to provide the high availability with low down time.
5) Data center are of very high cost.
6) Have to maintain large number of systems for software tastings.

2.1. Virtualization Projects: Key Problems

Despites the advantages of the virtualization, lots of organization having and faced different kind of issues during and after adoption of the virtualization technique. Or in short way you can say the three different problematic stages of virtualization are [20,21,22]:

1) Proper planning and analysis of the virtualization.
2) The period of adoption and post adoption.
3) Virtual machines infrastructure maintenance.

2.2. Support and Compatibility

This includes the evaluation of the existing hardware and software modules of an IT organization to find out the possibilities in the field of migrating to a new virtual environment. The big key problem with this was software developers were not 100% sure that the existing infrastructure will work proper in the new virtual environment and the solution was taking inventory of hardware and software. Many developers published the compatibility matrices of different hardware and of virtual machines regularly.

We can divide the support problem of virtualization in three parts [20,21,22]:

1) Technical limitations.
2) Strategies for market.
3) Political strategies.

2.3. Licensing

There are some limitations and problems on using the hardware and software in combinations due to the limitations of support. Certain software are not supported in virtual platform so you have to examine licensing support thoroughly with respect to the

licensees and openly exist software and hardware. Some software are not supported in virtual machines and failed to startup for example Microsoft vista home basic failed to startup.

Since it's very easy to move virtual machines from one physical server to other, so O.S. vendors introduced some limitations for using their products in the virtual machine. This type of limitations is described in the license part.

2.4. Deployment Planning

Planning of the deployment is very important part in the field of virtualization. It includes the things like deploying the consolidated virtual machines/servers, migrating of the servers, and the most important is obtaining the ratio of virtual machines (means the number of virtual machines per physical host). Some manufacturers of the virtualization provides the tools to calculate the virtual machine ratio like VMware provide the VMware capacity planner or you can use some third party software to calculate the same [23].

2.5. Training of Staff

This problem is one of the major problems in the field of virtualization as the number of experts are very limited in this field, who can deploy and maintain the virtualization infrastructure. Heavily use of virtualization is really required to train the staff seriously. So to get the experts and such trainers are really very expensive. The lack of specialist also a reason why organizations refuses to start using the virtualization.

2.6. Evaluating the return of investments

Most of the companies are not able to calculate the return on virtualization implementation caused them to not call it as unsuccessful. Some problems exist with the tools to calculate quantitative and quality measurement of the virtualization implementation.

3. FUTURE BENEFITS OF VIRTUALIZATION

- Virtualization will increase the operational flexibility of the information technology infrastructure.
- Virtualization will increase the productivity of the information technology infrastructure.
- Virtualization will really save the Hardware, Maintenance and Labor cost of redundant environments in the information technology infrastructure.
- Virtualization will make better utilization of the hardware of the information technology infrastructure.
- Virtualization will do a better failover in comparison with existing manual or auto failover methods in the information technology infrastructure [24,25].

4. CONCLUSION AND FUTURE PERSPECTIVES

Virtualization has been improved a lots in last few decades but still have some existing issues in the same field. Physical virtual machine failover is the most important and

critical at this point because there is no proper existing way currently to make a better error free virtual machine failover. There are lots of possibilities to improve the term load balancing, failover and virtualization. We can make the application load balancing better by introducing the active and passive hardware load balancer layers between the client and the backend servers and failover can be improved in a lot's of new manners.

Currently there is no proper way to make primary machine and secondary failover machine in proper synch for the better failover. There are lots of ways and algorithms developed for inter communication between primary and secondary machine but still this is a hot issue in the field of information technology. If we go in our approach then we can build up a mechanism of heartbeats which will provide the communication between the primary and secondary failover machine and in case of communication breaks by the primary machine then the migration process will start to the secondary machine. To be in synch, primary machine will send a heartbeat to the secondary machine to inform that it is available and secondary machine will acknowledge the signal in every 2 or 3 seconds and if secondary machine is not able to get defined consecutive signals from the primary machine then the migration from primary to secondary will start. But still have some issue with this mechanism like if there is some network breakage between the primary and secondary machine then they are not able to communicate with each other and however the primary machine is working, the migration will start. So apart from the heartbeat mechanism we need to figure out some alternate and perfect solution for the 100% correct migration. Since the network is the only communication channel between machines and servers so we have to develop a mechanism so that the secondary failover machines can be shared between several primary machines and the proper communication between primary and secondary failover machine should be maintained. We can make the communication via different sub nets so that in case of problem on a particular sub net the another will able to communicate with the primary machine. But in that case also we have to make sure that only one sub net communication is active at one time and secondary will active only when the primary one will not able to contact backend machine.

So organizations are started accepting virtualization worldwide but still have some open issues are there and by developing many new systems and mechanisms we can make this field further better so that all organizations should start taking benefits of virtualization without any hesitation.

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