WORK PLAN

I have divided work plan into many phases in conjunction with the system analysis and design. Initial way is determine the existing and capabilities of the load balancing, failover and virtualization in the current market. The previous key problems, solutions and the current key problems. The reasons why virtualization still has not been implemented by most of the organizations and what we can do further to make better utilization of virtualization and explore the further enhancements.

4.1 Key Points

1) Identify and analyze the existing virtualization solutions where it is already deployed and implemented.

2) Identify the things like what are the current virtualization service provide companies are doing in the field of virtualization.

3) Identify the solutions on how the virtualization will improve the failover, load balancing and virtualization.

4) Identify the challenges come in the way to get the trained resources or staffing.

5) How will virtualization will really save hardware, infrastructure, labor and maintenance cost of the IT infrastructure environment.

6) Identify the current issues going on related with the virtualization.

7) Identify how failover can handle in a better way.

8) Identify the support of virtualization with the legacy hardware’s and what we can do further to paired and operate them more efficiently with the virtualization layer.

4.2 Executing work plans

Following are the guidelines will use during the executing of the work plans:

1) Meetings and data collection
The main purpose of the meetings and data collection is to gather the information about the existing implemented solutions, advantages and disadvantages. The nature of current work, if virtualization is currently implemented anywhere or not, if implemented then what are the challenges there, Complete study of the implemented solution, how the load balancing and failover are achieving and the total time frame currently required for the failover with the current implemented solution. Whether the proper load balancing is happening or not and the implemented solution is giving the performance as expected. These all the information can be gathered by interacting with the experts already working in the same environment or in the implementation phase. Once data collected properly then we can analyze the situation properly.

Data collected in the following different way -

- Type of servers (Linux, Solaris, Unix etc), number of servers and storages
- Topologies and location of the servers, distributed, collocated or consolidated
- Estimation of the hardware and storage utilization
- Protection and security levels
- Current backup strategy
- Type of switching networks if there are any in place
- Applications deployed
- Severity of the different applications
- Service level agreement for performance and availability
- Current problems and constraints

2) Understanding and constructing the business cases

Understand the current nature of business, if the high availability is really required or not, if the business needs their application to be available more than 90% then there is a need of highly available solution. So first proper understanding of the business is required and further on the basis of information we can create the cases to analyze further how we can integrate or implement virtualization in the existing environment without any complications.

3) Benefits for the business

Analysis of the complete life cycle for the benefits for business and organization. Will it really going to benefit business from operational as well as from functional point of view.

4) Rules-of-thumb when constructing a storage virtualization business case

Key rules while designing the storage virtualization solution.

5) Key risks and impacts of virtualization implementation
Before implementing virtualization all the involved risks and impacts should be identified properly.

6) Design the solution

A proper design of the architecture.

7) Testing results

Proper testing of the architecture on test environments and in LAB before implementing in the live production environment.

8) Reconciling plans with actual

9) Dissolving the effort

5. HYPOTHESIS

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 challenges, I 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.

5.1 Earlier problems and requirements

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.

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

1) Average load of production servers are low
2) There is no specific hardware requirements
3) Has to manage large number of computers
4) Has to provide the high availability with low down time
5) Data center are of very high cost
6) Has to maintain large number of systems for software testings

So if your environment has all the above requirements then you must need the virtualization to achieve:

1) Create multiple virtual machines on a single physical machine in a consolidated way, reduce you energy and hardware cost, and make them flexible to migrate from one system to another.
2) Sufficiently management and maintain hundred percent availability by using the proper failover and backup solution
3) Make you testing environment more flexible by creating shared storage solution so that software can move from one machine to other in a easy way.
4) For presentation and testing create you independent isolated hardware environments.

5.2 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:

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

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 & software’s.

You can ask developers to make sure how well they work in the virtual environments. Many developers published the compatibility matrices of different hardware’s, virtual machines and software’s regularly.

We can divide the support problem of virtualization in three parts –

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

Licensing

There are some limitations and problems on using the hardware’s and software’s in combinations due to the limitations and support. Certain software’s are not support in virtual platform so you have to examine licensing support thoroughly with respect to the licensees and openly exist software’s and hardware’s. some software’s are not support in virtual machines and failed to startup for example Microsoft vista home basic fail 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.

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’s to calculate the same.

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 your staff seriously. So to get the experts and such trainers are really very expensive. So the lack of specialist also a reason why organizations refuses to start using the virtualization.

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 successful. Some problems exist with the tools to calculate quantitative and quality measurement of the virtualization implementation.

5.3 Hypothesis

Consequently, by adopting the concept of high availability using virtualization I have formulated the following hypothesis:

**Hypothesis 1**
Virtualization will increase the operational flexibility of the information technology infrastructure.

**Hypothesis 2**
Virtualization will increase the productivity of the information technology infrastructure

**Hypothesis 3**
Virtualization will really save the Hardware, Maintenance and Labor cost of redundant environments in the information technology infrastructure.

**Hypothesis 4**
Virtualization will make better utilization of the hardware’s of the information technology infrastructure.

**Hypothesis 5**
Virtualization will do a better failover in comparison with existing manual or auto failover methods in the information technology infrastructure.

6. METHODOLOGY

The main goal of my research is to implement and test failover and load balancing using a highly available clustered environment with respect to hardware and applications by using Oracle Linux Servers, Linux virtual machines, OHS (HTTP) Server, Hardware Load Balancer (BigIp) and Database.

6.1 Objective

This chapter will explain the methodologies used, including the hardware, software, design and analysis and validation methodology.

Review all the previous work done in the field of high availability clustered and virtualization and then develop an experimental testing alternate highly available clustered virtual environment with more advantages. Do the validation with native approach to validate the setup and then analyze the results[21].
So, I have formalized three objectives and going to use them throughout the project[22] –

1) Review previous works.
2) Developed and test experimental solution.
3) Analyze the system and results.

So, the different phases are:-

1) Phase I  - Proof of technology
2) Phase II  - Discovery / Recommendations
3) Phase III - Pilot
4) Phase IV - Production

6.2 Shared Storage System

Below is the example of shared storage in virtual environment.

For all nodes, disk images are stored in shared location which is available for all of the physical nodes. This will allow all the physical nodes to run all of the virtual machines and because of this the live migration of services is possible. In this example we have nine virtual machines running on three physical servers and sharing the same shared storage[23][24].

Virtual machine running on a physical system can be decoupled anytime and the services of that particular machine will takeover by the other system on same cluster. Even a physical machine can be decoupled from the cluster physical machines and the corresponding virtual machines will be failover to the other physical systems in the same cluster.
By developing this kind of system we hope that we can create an alternate solution for the application or services to achieve failover capabilities with redundant low cost and efficient solution. To achieve this automated failover capabilities there is a term called heartbeat is there, all the machines in the cluster will talk with each other by sending heartbeat or called a signal to ensure his availability, in case any of the server missed to send heartbeat the other servers will take that server as failed and will automatically migrate the services of that system to other available clustered system[23][26].

Fig 2 : Resource Sharing [b]

Hardware like cpu, memory, nic and disk space distributed between the number of virtual machines hosted by that particular server. As shown in fig 3.2.c, physical server hosting the two virtual machines having own virtual hardware. There should be a hypervisor layer between physical server and virtual machines which act as mediator between them.

6.3 Hardware, Software and Tools

6.3.1 Hardware

I have done all my experiments using the standard X86 Oracle Linux servers because they are globally used by all of the organizations in the market as well as fully certified by the Oracle itself for virtualization[28][30].

6.3.2 Hardware Architecture of Testing Machines

**Two Oracle Enterprises Linux Servers (X86)**

Each one with configuration:-

1) 16GB of RAM
2) Multiprocessors (Total 12)
3) 2 NIC Cards
4) 500GB of disk space
The main requirement of the live application migration is the share storage for the application binaries and data which is shared between all physical machines so the 500 GB of storage has been shared between both physical machine using NFS.

Since storage is shared, so the necessary components need to failover during migration is cpu, memory and user connection states.

### 6.3.3 VMware vSphere Hypervisor (ESXi)

VMware vsphere hypervisor is based on VMware ESXi, it’s a solution to virtualized a physical node in different virtual machines. It allows you to create and run a virtual machine from scratch in minutes and make it operational[18][19].

### 6.3.4 Software’s

**Database**

Oracle 11.2.0.2: Database is the main important part of any business environment. It’s used to the physical data of any organization. I have used oracle database version 11.2.0.2.

**Application Server**

Oracle Weblogic Server 11G: Weblogic server is the Java J2EE based application servers.

**OHS (HTTP) Server**

Oracle OHS server: It’s a oracle web server just like attaché http server

**Hardware Load Balancer**

BigIP: It’s a hardware load balancer tool from F5.

**Development Software**

Developed in java J2EE and deployed on weblogic application server.
6.3.5 Testing Environment Setup

Fig 4 shows the architecture setup for the test of failover & load balancing testing on the LAB environment.

There were four virtual machines and out of four, two machines exist in the DMZ public zone and the other two machines exist in the private internal zone.

Database has been installed on two different virtual machines as a RAC (Real Application Cluster) setup.

Weblogic server, OHS server installed on both internal machines and only OHS server installed on the DMZ zone machines[15][17][19].

Under weblogic server, created four clustered managed servers on which deployed the web portal application. So total we have eight managed servers where we have equally deployed the web portal application.

Two hardware load balancers are there, one at the public zone level and other one at internal zone level.

6.3.6 Failure

As discussed earlier, all the servers in the cluster communicate with each other by using the heartbeat mechanism and the same mechanism used to know the shutdown or crashed events. In case of failure of a machine failover happened when other machines in the cluster are not able to listen the heartbeat of the crashed server.

With respect to the failures in terms of the heartbeats, we can divided the failure in two major category –

1) Planned or Graceful

2) Unplanned or Uncontrolled

And each outage can be due to any of the below factor
1) Software (Application)

2) 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.

6.3.7 Validation Methodology

6.6.7.1 Validation Using OHS (Oracle HTTP Server)

Load balancing testing carried out at the first entry point called Oracle HTTP server (OHS).

Hardware load balancer were configure in conjunction with OHS server where –

1) Any request will come to the public zone bigip should forward to any one of the public zone MT OHS servers and further ohs servers should forward request to any one of the managed servers.

2) Any request will come to the internal bigip should forward to any one of the internal MT OHS servers and further ohs servers should forward request to any one of the managed servers.

![Validation Diagram](image)

6.3.7.2 Validations Using Weblogic Server & Access Logs

DMZ (Public Zone)

Request was distributed from hardware load balancer any one of the OHS server in dmz zone and from OHS server to any one of the internal managed server among eight managed servers. If there is firewall then internal managed server ports need to be open from public zone to internal servers. Once the request full, the portal page will display to the end user. To avoid extra burden on the network, SSL configured at bigip (hardware load balancer) level.
Internal Zone

Fig 7 represents the internal architecture where request from internet will come to internal OHS server via firewall and from internal OHS will be redirect to internal managed servers via another firewall.

6.3.7.3 Virtual Machine Fault Tolerance Testing

VMWare fault tolerance provides you the high availability by running a parallel virtual machine to take over the services from primary machine just in case of the failure of that machine.

The reason behind the failure is same as when machines in the cluster not able to communicate with each other.

Below three scenarios may occur:

**Deterministic Scenario**

1) ESX host failure which would cause complete host failure.

2) Any of the primary server process will be unresponsive.

**Reactionary Scenario**
1) Communication of NIC may be interrupted

2) Communication of NIC may be slow

**No Action Taken scenario**

Where failover not happened because of FT cannot monitor such type of events

- Interruption or failure of management network
- Interruption or failure of virtual machine network
- HBA failures that do not affect the entire host
- Any n number of combinations of all of the above

**6.3.7.4 Test VM High Availability – Machine Failover**

Create a new cluster

![Fig 8 : Machine Failover](image)

Add the servers to the cluster

![Fig 9 : Clustered Servers](image)
Before failover primary machine was on esx4

![HA Cluster](image)

Fig 10: failover to other machine

When I had shutdown primary machine then I saw Win2008 failover to esx3

![HA Cluster](image)

Fig 11: final result