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Virtualized DB Clustering and Server Consolidation: It's Implementation with a Live Case Study

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Abstract-Virtualization is a technology that transforms today's powerful computer hardware, which was designed to run a single operating system and a single application, to run multiple virtual machine having independent operating system. Many times, we observe that the server resources been underutilized. Virtualization allows us to efficiently utilize the available resources on physical machine. In virtualization environment, different virtualized machines can have different host operating system (i.e. different versions windows, Linux, Solaris etc). The most important concept to understand in virtualization is that, the virtual machines operating systems are independent from physical server operating system.

This paper is an attempt to illustrate and appreciate the concept of virtualization and its implementation by using a live case study which we have implemented for one of our leading ETL tool development for a client. Case study elaborates the implementation details about Virtualized DB Clustering and Server Consolidation.

Keywords - Virtualization; Clustering; Database Clustering

I. TYPE OF VIRTUALIZATION

A. Server Virtualization:

A computer server is said to be virtualized when a single physical computing machine is made to appear as multiple virtual machines. Each virtual machine has its own virtual CPU, memory and peripheral interfaces, and is capable of running its own operating system by maintaining operational isolation and keeping security intact.

It consolidates workloads for more efficient resource utilization.

- Reduce operating costs (Hardware, Energy, Space)
- Improve uptime and availability

- Enable robust Disaster Recovery
- Reduce maintenance disruption
- Streamline resource provisioning and scale

B. Desktop Virtualization:

Creates a separate OS environment over and above the existing running OS on the desktop. This allows a non-compatible legacy or LOB application to operate within a more current desktop operating system.

It creates an additional isolated OS environment on standard desktop.

- Support legacy applications in current Operating Systems
- Reduce application-to-OS conflicts
- Accelerate OS migration

C. Application Virtualization

It separates the application layer from the OS in a desktop environment which reduces application conflicts. By using this we can centrally manage patches and upgrades and accelerate the deployment of new applications. This also reduces the licensing cost.

It decouples applications from desktop operating systems to deliver on demand

- Reduce application-to-application conflicts
- Reduce application compatibility regression testing
- Centrally manage updates and patches

D. Presentation Virtualization

Presentation virtualization allows users to use applications remotely, without being physically present in

front of the server running the application. It decouples the user from the server running the application. The user interface of the application is transmitted to remote users using a network protocol.

Example is Microsoft Terminal Services

It allows centralize processing and data storage; present the user interface locally

- Reduces Application-to-Operating system conflicts
- Streamline the compliance and data confidentiality
- Reduce desktop administration costs

E. Storage Virtualization:

Storage virtualization is the pooling of multiple physical storage resources into what appears to be a single storage resource that is centrally managed.

Storage virtualization is commonly used in file systems, storage area networks (SANs), switches and virtual tape systems.

F. Network Virtualization:

In this virtualization one or more virtual machines can access the local or external network using the physical network adapter attached to physical machine. It can also be connected without physical network adapter (Uses logical network adaptor). In Virtual machine if the physical adapter is selected then it will get IP address from LAN, which allows it to communicate with network belongs to Physical machine network. If it connects without any physical network adapter then it will be part of internal virtual network.

II. LIST OF ADVANTAGES

- Cost saving and Power saving
- Saving License cost
- Require less Space
- Ease of system administration
- Less cooling
- Less total cost of Ownership
- Efficient resource utilization

- High Availability or Low downtime
- Faster disaster recovery
- Best suited for testing and dev. Environment.

III. VARIOUS VIRTUALIZATION TECHNOLOGIES

- VMware (GSX, ESX, VMware workstation etc).
- Microsoft (Virtual PC , Virtual server , Hyper-V etc)
- Open VZ (Open source container-based virtualization on Linux)
- SUN (Solaris 10 Containers)
- HP's Virtual Server Environment(vPars, nPartitions, and IVMs)
- IBM (PowerVM Virtualization)
- VirtualBox (VirtualBox , it is a Open Source)

CASE STUDIES

IV. CASE 1: VIRTUALIZED DB CLUSTERING

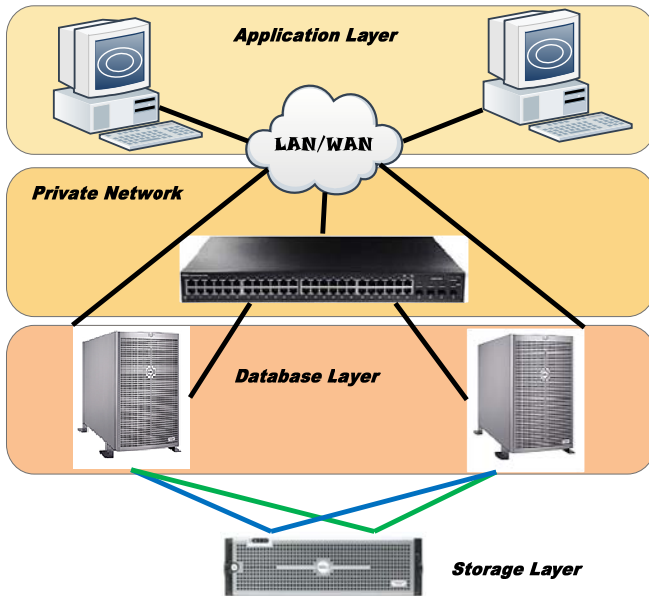
A. Back Ground:

We wanted to a test one of our existing product (ETL Tool) in a Virtualized DB Clustering Environment. This was new to us and we did not have any existing setup for the same. As we know, now a day's maximum production industries do use various kinds of databases and application in a clustered environment, to take the advantage of load balancing and fail over. So we thought of doing in a clustering way using virtualization.

B. Constraints:

We have constraints like, Hardware setups, Lead time, Procurement process, Cost for Customer and Very less time for implementation.

Physical Architecture of Cluster



C. Solution Suggest:

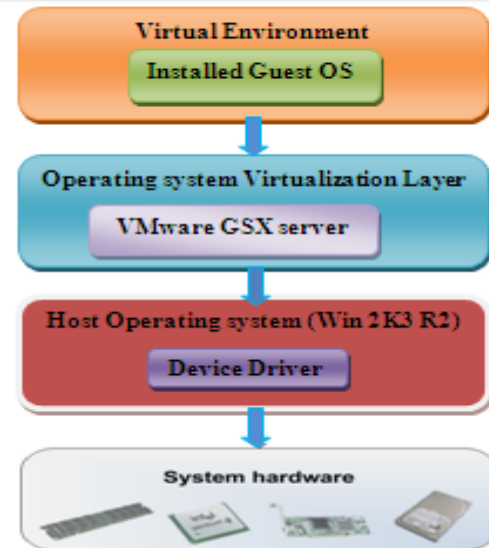
We did a cost benefit analysis to get a better solution and we proposed to prepare the setup in a virtualized environment using existing high end DELL power-edge server, VM Ware GSX Server. Below table shows the complexity of the environment support for the ETL tool development. ETL tool development supports following flavor of OS and databases.

Oracle 9iR2/10gR1/10gR2/11gR1	Windows NT/2K/2003/2003 R2 both x64/x86/Vista Ent/Business
Sybase 12.5.4/15.0/15.0.1/15.0.2	Solaris 8/9/10(English and Japanese)
DB2 8.1/9.1/9.5	HP-UX (11.11)
MSSQL 7/2000/2005/2008	HP-UX Itanium (11.23)
Informix 9.3/10.0	AIX (5.1)
Altibase 4.3.9.	Windows 2003 R2 Enterprise Itanium

To meet the above requirement in terms physical setup, it would have been very costly. So to implement and test this, we planned to prepare a setup with MS SQL 2000/2005 and Oracle 10gR2 cluster using virtualization. Finally we have procured 2 High End PowerEdge 6800 server for implementation.

Oracle Cluster is prepared on VMware GSX server and MS SQL 2000 and 2005, both running on VMware GSX server and MS Virtual 2005 Virtual server. Both the products are freeware for development and are available for testing purpose.

Implemented Virtualized Cluster



D. Cost Benefit Analysis for the Customer:

• Cost comparison with respect to Hardware Cost

- Without virtualization: Price of Hardware cost for physical environment (6 sets of DELL PE 6800 servers and 3 sets MD 3000 storages) = 6 x 400 K + 3 x 600 K = 4200 K INR

- Suggest solution price: Actual Price of Hardware (2 sets of DELL PE 6800) using the Virtualization = 2 x 400 K = 800 K INR

Cost Saving on Hardware only = 4200 K – 800 K = 3600 K INR

- Cost comparison with respect to power consumption:

- Without virtualization: Power consumption for 6 sets of DELL PE 6800 servers and 3 sets MD 3000 storages boxes for 2 years duration = 2 x 365 x 24 x (6 x 1.570 + 3 x .478) x 4.5 = 855729.36 INR = 855.729 K INR

- Suggest solution price: Similarly power consumption for 2 sets of DELL PE 6800 server for 2 years = 2 x 365 x 24 x 2 x 1.570 x 4.5 = 247557.6 INR = 247.557 K INR

Cost Saving on Power consumption for clustering = 608.172 K INR

- Cost of Virtualization software (VMware GSX server and MS Virtual Server)

VMware GSX server is free for testing and development and it is only charged, if we go for support. As we are the existing customer from the same vendor, we got the support with 9000 INR (\$200). Similarly Microsoft virtual server is also free for testing and development. Microsoft won't take any support fees for enterprise customers for this product. Around December 2005 Microsoft was charging only 99\$ for the MS virtual server but that option is no longer available. This is because VMware is major competitor for them; they want to maximize their customer base. Again Hyper-V also comes free with Microsoft's latest server version of windows Sever 2008.

Cost for virtualization product purchase is = 9 K INR (because we used freeware).

So Total cost saving on Hardware and power consumption is around 4200 K INR

E. Assumption:

- Power rating of DELL Power Edge server is 1570 Watt and Power rating of MD 3000 storage is 478 Watt.
- Price of Dell Power Edge Server is : 400 K INR and Price of MD 3000 storage is 600 K INR
- Per Unit Price of power is: 4.5 INR
- Product Testing was done for 2 years = $365 \times 2 = 730$ Days.

F. Few Other Benefits listed below with respect Virtualized DB clustering

- Space saving
- Ease of administration
- Less space required
- Efficient use of resource Utilization
- Power saving on cooling
- Ease of dismantle
- Set up and recovery time is very low
- High availability and low downtime

V. CASE 2: SERVER VIRTUALIZATION

A. Back Ground:

We have around 36 no's of desktops (configuration of each machine is PIII, 512 MB RAM and 40 GB DD etc). This low end machines are been using for QA and localization product testing. As this product support international clients, so all these desktop are loaded with Multi-boot OS (Windows XP, Windows 2000, Windows 2003, Windows 2003 R2, Windows NT etc) with various localized languages (English, Chinese, Japanese, French, Korean, German). If we look at the purchase date of these machines are around year 2002- 2003, which seems pretty old and not covered under warranty or AMC. That leads to low performance and frequency of hardware failure is very high. It is also difficult to get the spare part from market. In this scenario we thought of going for buying new desktop to replace the existing setup.

B. Constraints:

Convincing customer, Hardware setups, Lead time is high, Procurement process in various level of approval, Cost for Customer, less time for implementation.

C. Solution Suggest:

Here also we did a cost and benefit analysis to have a better solution for this implementation. We proposed to prepare the setup in a virtualized environment using High End DELL power-edge Server, VMware GSX Server. All 36-40 sets of machine would be migrated to virtualization environment. Rather than going for purchase of around 36-40 sets of desktop we proposed to purchase 3 sets of High End DELL PowerEdge server and all the desktop setup to migrate to virtualized high end server.

D. Cost Benefit Analysis for the Customer:

- Cost Comparison with respect to Hardware cost
 - Without virtualization: Proposed Price of Hardware cost for 36 no's of Desktop equals to $36 \times 50 \text{ K} = 1800 \text{ K}$
 - Suggest solution price: Actual Price of 3 no's of Sever Machine equals to $3 \times 400 \text{ K} = 1200 \text{ K}$
Cost saving on Hardware only = 600 K INR
 - comparison with respect to power consumption:
 - Without virtualization: Power consumption of 36 no's of Desktop for 2 years = $36 \times 2 \times 365 \times 24 \times .200 \times 4.5 = 567648 \text{ INR} = 567.648 \text{ K INR}$
 - Suggest solution price: Power Consumption of 3 no's of Server for 2 years = $2 \times 2 \times 365 \times 24 \times 1.570 \times 4.5 = 247557.6 \text{ INR} = 247.557 \text{ K INR}$

Cost saving on Power Consumption only: 320.091 K INR

- Cost of Virtualization software (VMware GSX server and MS Virtual Server)

Cost for virtualization product purchase is = 9 K INR (because we used freeware).

So Total cost saving on Hardware and power consumption is around 911 K INR

E. Assumption

- Power rating of DELL Power Edge server is 1570 Watt and Power rating Dell Desktop is 200 Watt.
- Per Unit Price of power is: 4.5 INR
- Product testing was done for 2 years = $365 \times 2 = 730$ Days.
- Price of Dell desktop is around 50 K INR and Price of Dell Power Edge 6800 server is 400 K INR

F. Few Other Benefits listed below with respect to Server Virtualization

- Space saving
- Ease of administration
- Less space required
- Easy switching between operation systems
- Efficient use of resource Utilization
- Power saving on cooling
- Set up and recovery time is very low
- Very good setup for testing and development
- Ease of backup

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