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A Study to Develop Server Virtualization Infrastructure in Educational Institutions with Cost Effective and Green Computing Approach

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ABSTRACT

Cluster computing has emerged as a result of the convergence of several trends, including the availability of inexpensive high performance microprocessors and high speed networks. This also enables the development of standard software tools for high performance distributed computing, and the increasing need of computing power for computational science and commercial applications [2], [8], [27]. Server Virtualization has evolved to support applications ranging from supercomputing and mission-critical software, through web server and e-commerce, to high performance database applications [13].

The Educational Infrastructure Management is an expensive concern. Libraries, Computer centers and laboratories, classrooms, Internet services, campus wide network are the basic infrastructure of any educational organization. Frequent replacements, upgradation of the hardware, software in computer related infrastructure is often [5], [24], [25]. Many courses in the computing booklet can benefit from hands-on educational activities in the form of laboratory components associated with the lectures. This courses technology enabled these to switch from a mostly descriptive content to learning activities which engage students in hands-on, authentic, problem-based learning [4], [20], [24].

Educators have an opportunity to teach many types of topics related to cluster computing in universities at various levels [2]. "Green computing" represents environmentally responsible way to reduce power and environmental e-waste [21]. One of the primary goals of almost all forms of Virtualization is making the most efficient use of available systemresources and optimizing it at high level [9].

This paper explores how some virtualization and clustering technologies can be deployed to provide students, as well as instructors, with an optimized environment.. We focus on providing solutions which can integrate transparently to any campus without involving significant changes to the classroom computers.

Keywords:- *Clustering, Educational Infrastructure, Green IT, Open Source, Virtualization, Virtualization Environment, Virtual Machines.*

I. INTRODUCTION

It is an important aspect of educational infrastructural management. As the global financial turmoil highlights the increasing costs associated with creating and supporting computer hardware and the space it occupies, servers in the Educational Infrastructure management are attracting attention [3].What are the needs of virtualization in the academics and its literature review is discussed. Why we need VMware technology for this platform and its methodology is followed. Significance and its application usage over virtualization platform are studied. Nowadays the educational institutes are facing a big challenge related building of computer infrastructure.

If a proper virtualization infrastructure is built then it will perform following functionalities: Virtualization offers a first-step solution to the cost equation that arises when technology contends with space and other resources [3], [15]. In this paper, server virtualization is proposed as a remedy to infrastructure demands and also an attempt is made to evaluate virtualization educational infrastructural management domain, with a particular emphasis on how new virtualization technologies can be used to simplify deployment, improve resource efficiency, and reduce the cost of reliability.

To use Standard procedure for developing virtualization kit in Education System and to develop a Quick cluster of virtualization, with high repeatability index, which can be replicated anywhere in about 2-3 hrs. To standardize the process such that it can be taken up with minimum hardware usually found in UG/PG laboratories of colleges. To load open source development tools for distributed computing. To design and standardize a PG lab session (3 labs

of 3 hrs. each) which can be performed on these setup. To popularize this method or standardized procedure with the colleges (Engineering / MCA / MCS,...) so that it becomes a part of their teaching course. A primary goal is to understand the key reasons for the development of virtualization technology that supports low-cost high performance and high availability computing [23].

II. NEED OF VIRTUALIZATION IN EDUCATION

At present, the network infrastructure construction has been basically completed in colleges and universities. It is the main task of colleges and universities to apply the maximum effect of the server operating in network and to facilitate the management and configuration of the server. It is the top priority of the network center administrator to employ the server resources safely, reasonably and efficiently [14]. Current processes of building small clusters are all ad hoc and there are hardly any reliable standardized methods for implementing in laboratories with proper checklists, compatibility documentations, min selected software kits all provided as one single unit.

Even with all of the available resources for virtualization education, it is difficult to design a good course that covers a reasonable subset of topics of virtualization computing. Many typical undergraduate or graduate courses have significant overlap with the topics that may also be covered in a cluster computing course. For example, undergraduate courses in operating systems, networks, computer architecture, algorithms, or Java computing may cover topics such as threads and synchronization, network protocols and communication, or issues related to symmetric multiprocessing [1], [22], [26].

There are also problems existing in the Laboratory demanding to be addressed: scientific research and student projects require high performance experimental environment; it is difficult for colleges and universities to provide a unified mass server environment for students to experiment; it is a problem to deploy the server environment in a bulk and unified way; it is a great consumption of energy to construct the project environment repeatedly [7], [12], [14].

A. International status

Many universities all over the world, including those in developing countries, have used server virtualization as a platform for virtual computing [2]. Many resources are available for teaching cluster computing. For example, the IEEE Computer Society Task Force on Cluster Computing (TFCC) provides online educational resources. Following are the few outside universities which carry cloud computing in the class room.

* University of Arkansas- Clusters Computing.
* Monash University-Parallel System.
* University of Southern California (USC)-Linux Clustering.
* USC Trojans cluster research group-distributed software RAID.

B. National status

* University of Hyderabad-parallel processing.
* University of Gujarat-Cluster computing, etc.

The above universities and other few universities (Except Abroad Universities) which provide Virtualization theoretically but not in a standardized method. So this platform with a standardize kit will provide a utilization of infrastructure as well as implementation of application with cost effective and green computing approach. Demonstration and Hands on activity will be a main role of this study which is carried through methodology shown in this paper.

III. SIGNIFICANCE OF THE RESEARCH

Cluster computing provides an inexpensive computing resource to educational institutions. Colleges and universities need not invest millions of rupees to buy parallel computers for the purpose of teaching "parallel computing"[6], [8], [14].

A single faculty member can build a small cluster from student lab computers, obtain free software from the web, and use the cluster to teach parallel computing. Virtualization, Clusters can be used in practical of many courses taught at UG and PG and in colleges in India. Courses such as

-MCA-ADBMS (IT34), OS (IT55), Mobile Computing (ITE1), AIT (IT55),

-MCM-Networking (405), BCA -System Programming & OS (603), NW (401).

-BE-Mobile Computing (410450), Cloud computing (410450-iv-3).

-ME-Network Designing & modeling (510110), Network programming (510111 c)-(Syllabus from Savitribai Phule PuneUniversity, India).

-And also other courses like B.Sc., M.Sc. etc.

Para-virtualization and its Clustering in building of private cloud [16], [21].Study of Virtual Ware and its benefits for virtualization platform can be built and designed e.g. VMware [11], [18].

No such educational kit seems to be available in the market at this time. Therefore this Standard procedure kit will be useful in many educational institutions [2], [20], [23].

IV. METHODOLOGY

This Experimental research has following procedure

A. Planning and Designing

The planning and designing of virtualization infrastructure environment is shown in Figure 2 and the comparision can be done from figure 1 shown as non-virtualization infrastructure. Cluster building, managing it, lab designing and hands on activity can be designed and plan from figure 2.

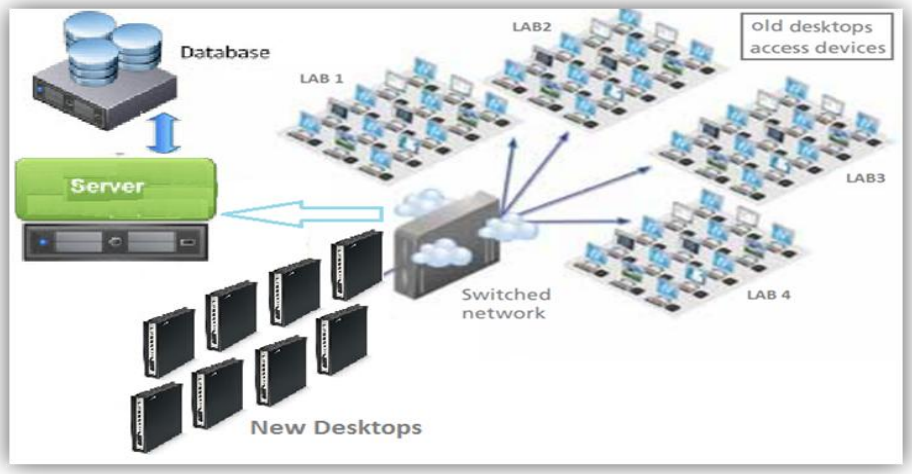

Figure 1 Non-Virtualized Educational Scenario

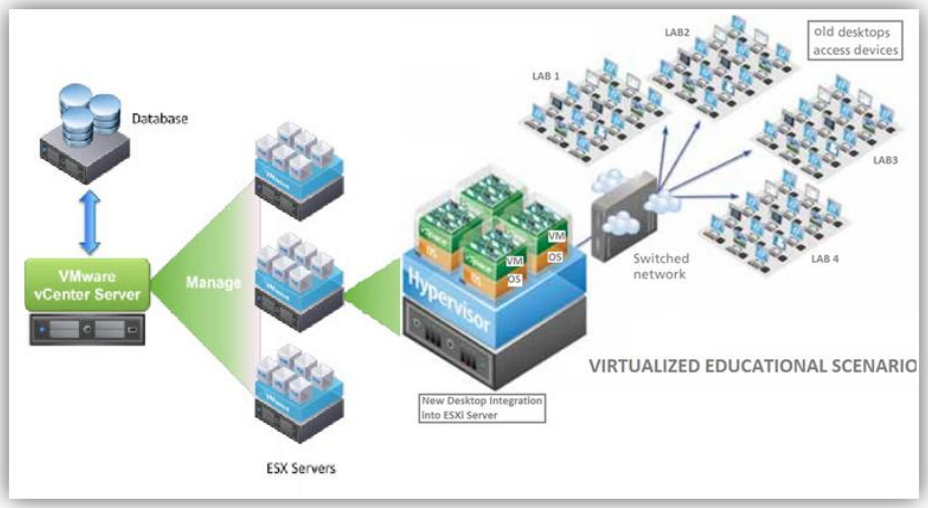

Figure 2 Virtualized Educational Scenario

B. Building of Server Virtualization platform:

By implementing VMware ESXi Server

Requirements:-

To deploy a server virtualization infrastructure, you'll need at least one dedicated systems i.e. Host machine along with 4-5 nodes machine.

***Single Cluster**

a. Configuration and deployment of ESXi 5.5 on Host machine.
b. Configuration and deployment of Domain Controller Windows 2008 R2.
c. Configuration and deployment of VM 1 on ESXi with open source operating system.
d. Configuration and deployment of VM 2 on ESXi with open source operating system.
e. Configuration and deployment of VM 3 on ESXi with open source operating system.

***vCenter:** Configuration and deployment

Building a network between Server and Client Nodes. Installation and configuration of network for building a Virtualized platform.

For the server and client node we will use Open source operating system like Linux (Red hat, Fedora, Centos) and Windows OS. The images will be created for each client nodes with the information stored in it.

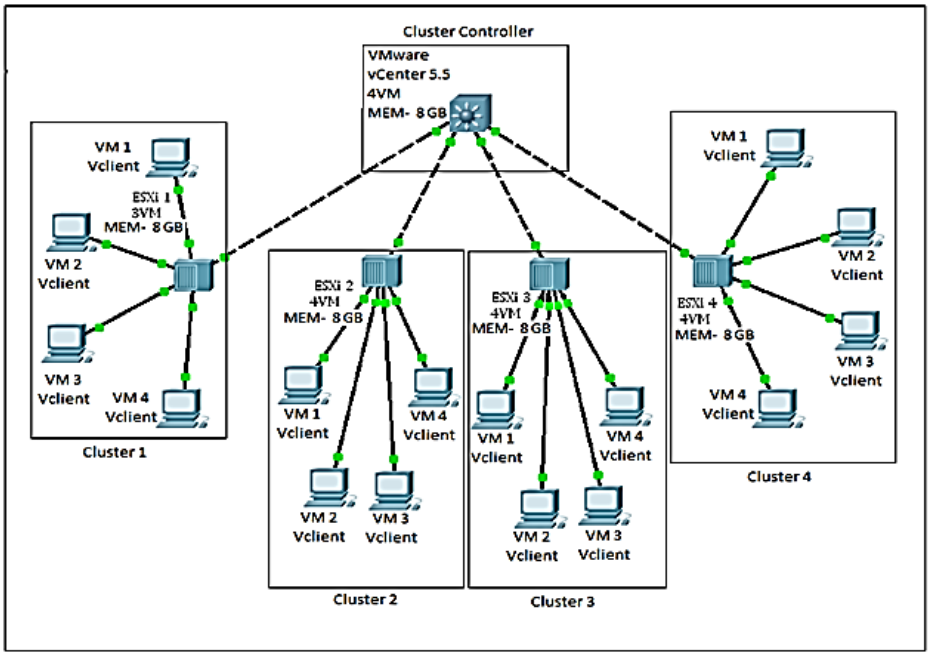

FIGURE 3: INTEGRATED CLUSTER ARCHITECTURE

The above architecture in figure 3 gives an overall structural design and basic resource availability. Integrated architecture is the combination of various clusters link together to the vCenter Cluster controller. This single cluster is the combination of various Virtual Machine (VM) nodes connected with single ESXi. Each ESXi uses New/ high configuration machine within the provided Lab with available Datastore. This VM are accessed via vClient software by either old desktop or thin client having low resources.

Phase I: Configuring the Server Virtualization platform:

The Server Node and Client Node will be configured so that the resources will be shared and monitoring will be done. The Server Node will Manage the all the Administrative Policy with the
privileges for various users allocated to the client Nodes.

Phase II: Validating the approach cost effective and green computing

By carrying test such as 1.Pretest 2.Posttest and 3.Control group using validating tools such as jeopardy and other.

Phase III: Monitoring of the Server Virtualization platform:

The monitoring information will be gathered and log files will be created. The various application of parallel processing, distributed systems, clustering etc are configured and implemented on Server Virtualization platform.

Tools to be used:

The main tool is VT which is required on Node System.

VT the minimum requirements are: All 2nd generation Intel core i3 or above processors.

V. WHY THIS HYPERVISOR? VMWARE ESXI

VMware ESX is an enterprise-level computer virtualization product offered by VMware. ESX is a component of VMware's larger offering, VMware Infrastructure, which adds management and reliability services to the core server product. VMware is replacing the original ESX with ESXi. VMware ESX and VMware ESXi are Type 1 hypervisors that are VMware's enterprise software hypervisors for guest virtual servers that run directly on host server hardware without requiring an additional underlying operating system [18].

VMware vSphere has been production-proven thousands of customer deployments all over the world. Other hypervisors are less mature, unproven in a wide cross-section of production data centers, and lacking core capabilities needed to deliver the reliability, scalability, and performance that customers require. VMware is the clear and obvious leader in virtualization products. VMware tried both the Microsoft and Oracle virtualization products and found them lacking in features and performance compared to the VMware product [10].

VI. COST EFFECTIVE

The main problem is to determine resource demand of each application and to allocate resources in the most efficient way. To deal with this problem the authors apply an economic framework: the system allocates resources in a way that maximizes the "profit" by balancing the cost of each resource unit against the estimated utility that is gained from allocating that resource unit to a service [29].

The basic parameters, structural design for cost comparison between virtualized and non-virtualized environment have been discussed in our previous research paper

VII. GREEN COMPUTING

The basic parameters for Green computing are as follows:

A. Managing Energy and Server Resources in Virtualized Environment:

The main resources are used in ESXi and vCenter Server for the management of Virtualized Environment via Thin clients or old desktops (which have less resource). In educational organization according to the available budget and current QoS requirements, i.e. balancing cost of resource usage (energy cost) and benefit gained due to usage of this resource. This enables a virtualized environment to improve the energy efficiency under fluctuating workload, dynamically match load and power consumption, and respond gracefully to resource shortages [29].

B. Ways to reduce IT Load:

Since powering the IT load in educational infrastructure is such a large portion of the overall electricity cost in a Virtualized Environment, reduction of this load must be a primary consideration in any energy efficiency initiative. There are a number of ways to reduce this load including the following:

*Virtualize or consolidate servers

*Reuse servers for ESXi which are no longer in use

*Enable power management

*Replace inefficient servers

*Power down servers when not in use

VIII. BENEFIT OF SERVER VIRTUALIZATION

There are number of benefits in educational organizations of virtualization. It reduces operational complexity, maintains flexibility in selecting software and hardware platforms and product vendors. It also increases flexibility in managing different virtual environments. Some of the benefits of virtualization are:

A. Server and application consolidation

Virtual machines are used to consolidate the workloads of under-utilized servers on to fewer machines, perhaps a single machine. It includes savings on hardware and software resources, management, and administration of the server infrastructure. In virtualization the execution of applications is well served by virtual machines. It consolidates various heterogeneous applications running on single platform for better utilization of resources.

B. Multiple execution environments and Resource sharing

Different operating system and various applications are accessed by students on different desktops or thin clients via this platform. Virtual machines also provide hardware configuration such as SCSI, Ethernet, CD / DVD drives devices. It can also be used to simulate networks of independent computers. In virtualization ESXi platform run multiple operating systems simultaneously having different versions like in Linux Fedora 11, 12 etc., or even different vendors like Linux, Windows etc. Virtualization empowers the operating systems, applications to run on shared memory multiprocessors. It also shares Datastore, network devices and many more resources.

C. Debugging and Performance

Virtualization in VM enables powerful debugging and performance monitoring tools. It also provides fault and error regulation by isolating applications and services on which they run [22]. Virtualization handles tasks such as system migration, backup, and recovery easier and more manageable. Virtualization is a great tool for research in academic experiments. They provide isolation, and encapsulate the entire state of a running system. Since we can save the state, examine, modify and reload it. Hence it provides an abstraction of the workload being run [28].

X. CONCLUSION

Make use of the high-density and management easiness of Virtualization Technology, make full use of the existing server resources of schools, provide for most students and research projects adequate VE, and to meet the requirement of research and teaching project on the server environment.

The infrastructure management is improved, the management workload is greatly reduced, and the server management/ maintenance cost is saved; the single point failure is reduced and the service guarantee level is improved; and the integral resources shortage due to low resources utilization is eased. The data security and disaster recovery capabilities are enhanced [14].

This platform with a standard procedure to develop a kit will provide a utilization of infrastructure as well as implementation of application with cost effective and green computing approach towards educational organization.

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