



Virtualization: A Tool to a Sustainable Education System

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Abstract-Technology which was once a rarity in the field of education has evolved into a necessity and still this field requires much more technology than it frequently gets. Virtualization is a technique that abstracts the physical characteristics of a given computing resource by creating virtual instances of the given computing resource. It also establishes software hardware equivalence thereby making technology an on demand service. In the field of education virtualization has impact on two significant areas: teaching, learning process and operational efficiency and costs of the learning environment. Virtualization also brings to the table several other benefits such as effective use of hardware, better data security, server and storage consolidation, increased scalability, reduced energy consumption and hardware refresh cycle savings. The concept of Virtualization has the potential to be the “next big thing” that can redefine the entire education system through the server and desktop effectively.

Keywords- virtual instances, virtualization, consolidation, desktop.

I. Introduction

India is a force to reckon with as an industrial economy but to emerge as a global superpower it needs to build on as a knowledge economy. In a democracy as big as ours it is discomfoting sight to see that the government cannot efficiently provide for the basic education needs of the economically poor section of the society. Economically poor parents look up to the government schools to cater to the needs of their wards [1].

Unfortunately these schools have so far failed in providing quality education to the masses. Drastic steps have not been taken by the government to improve the basic amenities, infrastructure, standard of education and quality of teaching right from primary to higher education institutions. As a result many of them are still in miserable plight.

In a survey conducted by the UNESCO's Institute Of Statistics the flaws in the present Indian education system were quite evident. One of the The most concerning issue was that of a 'degraded rural schools'. Despite 60% of the pupils being enrolled into rural schools and 70% of the public schools being concentrated in rural areas the quality of teachers and the access to basic infrastructure in these areas continues to be a mystery. Thus there arises a strong need for enhancing the existing condition of the rural education.

Another observation of this report was that of, 'Delivery of Course Curriculum and Refresh Cycle of Education Material':

One of the prominent factors that are a concern in education delivery is that currently no such mechanism exists that keeps pace with the field being taught. In addition many educationalists believe that the material being taught is too theoretical and vocational aspects remain uncovered.

Currently there are no methods for the timely revision of the textbooks and also there are significant differences between the books of private and public schools.

Besides several other steps to be taken by the government to improve the quality of teaching learning process in these institutions, technology is one of the most important solutions. It will not only accelerate the pace of learning but also make available the latest research, innovations and experimentations that have taken place in the field of pedagogy to both 'teachers and taught'. The government schools and colleges still lack in the use of technology. Whatever technology is available with them is not being fully utilized [2].

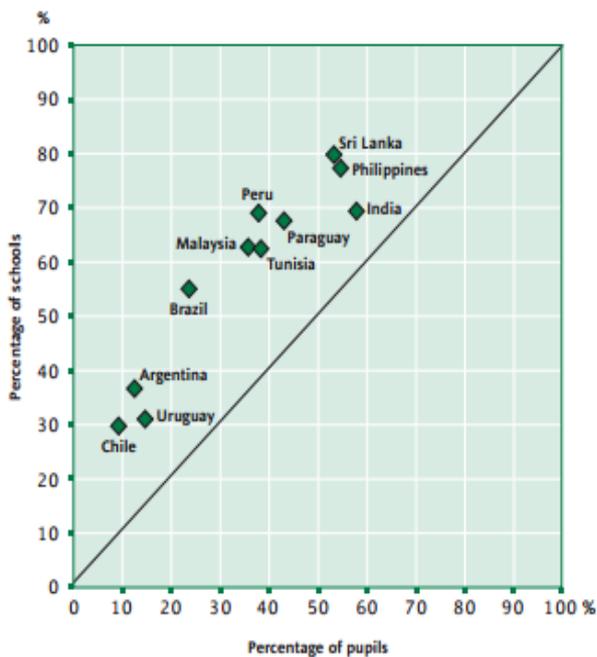
Technology is a buzz word these days. Integration of information and communication technology (ICT) in teaching learning process will certainly facilitate the learning process of students and improve teaching effectiveness in the classes. But low cost technology is the need of the hour for a country like ours. This paper aims at providing an effective and low cost technology that can revolutionize the quality of education in general and teaching learning process in particular. To empower the Indian education system we have intended to use the technology of tomorrow's virtualization [13].

Virtualization refers to the creation of virtual instances of the existing hardware that acts like a real computer with an operating system. It is based on the principle of software hardware equivalence. Software executed on these virtual machines is separated from the underlying hardware resources. For example, a computer that is running Microsoft Windows may host a virtual machine that looks like a computer with Ubuntu Linux operating system; Ubuntu-based software can be run on the virtual machine.

In virtualization, the host machine is the actual machine on which the virtualization takes place, and the guest machine is the virtual machine. The words host and guest are used to distinguish the software that runs on the actual machine from

the software that runs on the virtual machine. The software or firmware that creates a virtual machine on the host hardware is called a hypervisor or Virtual Machine Monitor.

Comparison of village schools and enrolment as shares of the totals



Source: WEI-SPS database.

Figure-1 rural schools and student ratio(WEI cross national study)

VIRTUALIZATION

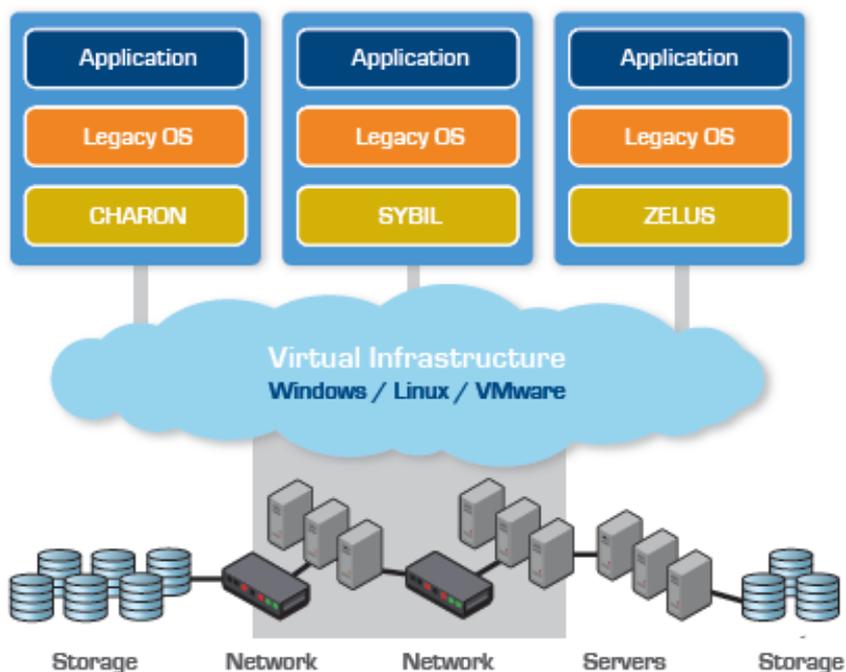


Figure 2-Model of virtualization

What is a Virtual machine?

A virtual machine (VM) is a software implementation of a computing environment in which an operating system (OS) or program can be installed and run. The virtual machine typically emulates a physical computing environment, but requests for CPU, memory, hard disk network and other hardware resources are managed by a virtualization layer which translates these requests to the underlying physical hardware. VMs are created within a virtualization layer, such as a hypervisor or a virtualization platform that runs on top of a client or server operating system. This operating system is known as the host OS. The virtualization layer can be used to create many individual, isolated VM environments. Virtual machines can provide numerous advantages over the installation of OS's and software directly on physical hardware. Isolation ensures that applications and services that run within a VM cannot interfere with the host OS or other VMs. VMs can also be easily moved, copied, and reassigned between host servers to optimize hardware resource utilization. Administrators can also take advantage of virtual environments to simply backups, disaster, new deployments and basic system administration tasks. The use of virtual machines also comes with several important management considerations, many of which can be addressed through general systems administration best practices and tools that are designed to manage VMs.

It will easily be accessible even to the remotest corners of the country.

Desktop Virtualization



Figure 3-Desktop Virtualization Model

Institutions in India have spent a year in search of an environment that includes software, hardware and storage –to get an appropriate solution which provides scalable computing and desktop infrastructure. It is basically an environment that would be able to cross the boundaries of day to day usage as well as research usage, while also keeping green practices in mind. Any environment that allows the IT group to do more with less or to do more efficiently with the same amount is always accepted well. Desktop virtualization decouples the operating system and the applications from client desktop to virtual computer running in the server where they can be secured and managed properly. With this approach a student can access their “virtual desktop” from any location with full personal computing experience thereby increasing the effective school hours. It takes the efficiencies offered through a centralized processing environment and merges it with the flexibility and ease of use found in a traditional PC. Whenever workstation users are currently working on fails, the student’s entire workspace is available on any other workstation on the network.

Desktop Virtualization uses a “thin client” a computer program which is depend on server to fulfil is computational roles. It is a technology that provides a reduction in total cost of ownership (TCO) through a combination of reduced hardware costs, reduced maintenance and support costs, reduced LAN/WAN bandwidth requirements and enhanced security. An older PC that cannot run versions of popular OS and desktop applications can do so when used as thin clients running virtualized desktop software. It uses about 15 watts of energy versus a regular desktop using 100 to 250 watts. It needs to be refreshed every 7 years on average [12].

Server virtualization

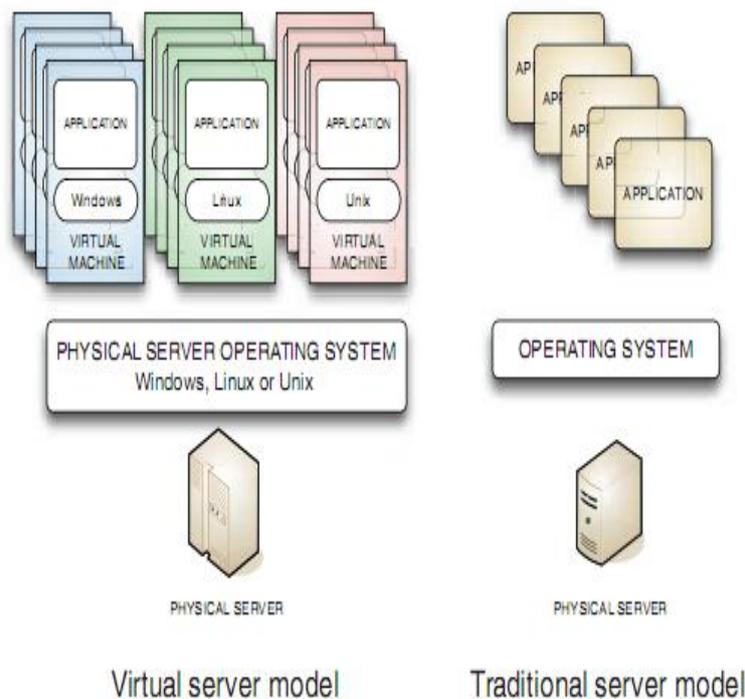


Figure 4-Server Virtualization Model

Server virtualization refers to the logical partitioning of a server component to run multiple secure virtual servers by creating multiple isolated environments. It allows multiple OS and applications to run on a single server thereby consolidating the server, which help to reduce hardware acquisition and management costs by eliminating ‘infrastructure sprawl’ at the server level. It breaks the rigid one server/one OS and one server/one application paradigms and reduces the number of physical servers one requires and increases per-server utilization. The workload balancing can be done through server virtualization, whenever resource requirements of any application in virtual server is increases and that server finds difficulty to handle, in that case that particular application is moved to another virtual sever. It also creates a more efficient and dynamic data centre infrastructure that optimizes server resources allowing applications to leverage a greater density of computing resources, facilitating rapid and seamless disaster recovery, reducing disruptive events and minimizing administrative time and resources[11].

Network virtualization

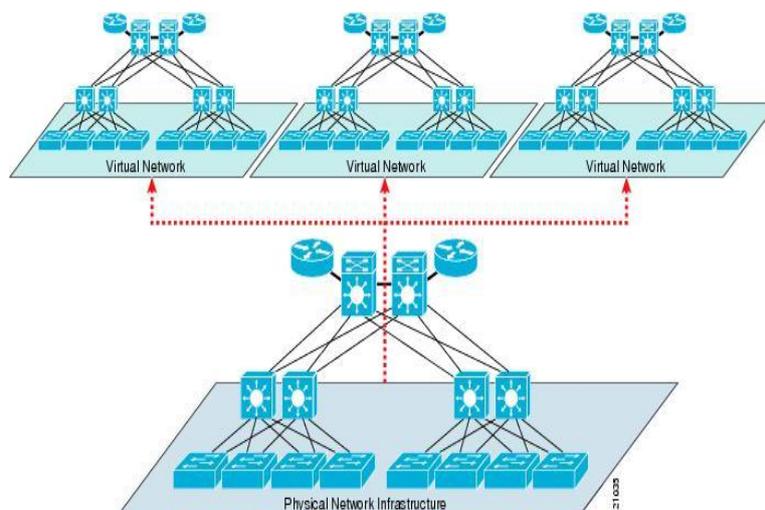


Figure 5-Network Virtualization Model

In the information age as more and more information is generated, there is a need to share and distribute information between heterogeneous and geographically systems and devices. There is always a hurry to distribute information which led to complex network over a wide range of distributed media: copper, fiber-optics, satellites etc. Virtualization of a network may mean a creation of a virtual network where multiple things depending on the business problem solved, but

essentially it refers to the creation of a logical network layer over the physical network resources. A technology called “VPN (Virtual Private Network)” is used to virtualize the network. There isn’t any need to setting a new physical network it sets up a logical layer over the existing network using a secure tunnelling protocol. It can be implemented at the end points or on the network. Here all the terminals are connected to server with a secured public network and confidentially of data that is being transmitted. The other technology is called VLAN (Virtual Local Area Network) which provides the mechanism where all the clients irrespective of their physical location in the network. Here partitioning of layer is done to create multiple distinct broadcast domains which are mutually isolated. It replaces the traditional LAN having the issues related to security. The sharing of data and files over the network a lot simpler and secure [4].

Objectives

Saving On hardware refresh cycle costs:

To ensure a 1:1 student computer ratio educational institutions need to buy new hardware that supports new OS and the latest desktop applications or they may buy workstations. But these are a very costly approach given the present fiscal times. Desktop Virtualization provides a way to increase the life of existing old PCs while reducing the costs of the workstations. Desktop Virtualization runs on the older PCs and less expensive thin clients replace the workstations. Even older PCs that cannot support popular OS and desktop application can do so when used as thin clients. Refresh rates of traditional desktop is 3-4 years while thin client are replaced in every 5 years. Thus the real beauty of desktop virtualisation is that it is easy to augment with new technology

-Lower Total Cost of Ownership:

As management of the virtualized PC clients take place mostly in the data centre rather than in classrooms the administration is highly simplified. Many system set-up and configurations operations that require a physical computer in traditional computing environment are a simple file copy operations in a virtualized desktop environment. Virtual client computing is one of the most powerful tools available students TCO.

Saving on Software Licensing Costs

With virtual desktop workstations one needs to purchase software licenses for the ‘peak instantaneous usage’ of any given product. Limiting the usage of a particular application to number of licenses in hand is a manageable task [6].

Deliver a Common end User Experience

‘Repair not Replace Strategy’ to enhance the delivery of the present education system and to use the preexisting old hardware to deliver uniform student experience regardless of the PC age.

Green Approach of Virtualization: Reducing power consumption with Virtualization

Virtualization is eco -friendly. As schools replace older PCs with thin clients there are enormous savings derived from reduced power consumption.

As server virtualization permeates data centers and reducing data center power consumption becomes a key initiative, using virtualization has become a key strategy among green data centers and those seeking greater energy efficiency.[5] With server virtualization, data centers can reduce server hardware costs, improve power management, reduce power and cooling costs, and reduce data center carbon footprint. But introducing virtualization into your green data center strategy involves myriad questions: should you use blades or rack mount servers in your data center? Does choosing Linux over Windows improve power management? Which metrics should you use to determine power savings and where? This section offers advice on using virtualization to reduce data center power consumption and provides company case studies and step-by-step instruction on improving energy efficiency with server virtualization.

-Better Data Security

In a virtual desktop environment all the computing resources are present at a secure centralised data centre instead of being spread over a network. Thus secure working environment are provided to teachers and various administrators.

-Providing a national teacher student portal:

Providing a secure common platform where students can post their queries and also gain a access to competitive exams via expertise available online.(Video conferencing)

-Extended school hours:

The students using virtual client technology devices can connect to the school network using family owned devices without compromising the security of the network. Students are encouraged to use curriculum resources on the school network effectively which lengthens the school day.

CHALLENGES:

Shortage of technological workforce that can cope up with the enhanced technological solutions to improve the quality of education.

Ignorance to adopt technology in the rural areas. (Solution: More often than not People in India are not appreciative of the new technologies. So work with those who appreciate tech and use them to propagate our technologies)[7]

Lack of basic educational infrastructure such as electricity, library and even sitting places for students. In a survey conducted by the UNESCO’s statistical department ‘the level of school resources’ in Indian schools emerged as a matter of concern which makes it very difficult to incorporate technology into the educational sectors[9].

TABLE 1 LEVELS OF SCHOOL RESOURCES
Percentage of pupils in schools that were reported to have selected resource items

	Electricity		Blackboard in each classroom		Sufficient sitting places		School library		Computer for administrative use		Computers for students to use with access to the Internet	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Argentina	98.7	0.25	98.9	0.44	88.0	1.39	79.7	1.35	75.3	1.61	22.9	1.34
Brazil	94.5	1.03	99.4	0.28	88.3	1.42	62.0	2.32	70.4	1.91	22.8	2.13
Chile	99.4	0.28	99.5	0.27	98.6	0.52	85.6	1.65	93.4	1.07	90.2	1.49
India	47.6	2.93	95.2	0.81	43.2	2.21	64.5	2.54	12.8	1.80	8.8	1.61
Malaysia	98.4	0.68	100.0	0.00	95.5	1.00	96.6	0.90	95.2	1.10	59.4	2.62
Paraguay	96.6	0.50	99.0	0.28	87.4	1.20	53.3	1.63	29.0	1.71	6.5	0.92
Peru	76.4	1.35	98.0	0.54	68.4	2.21	63.9	2.08	52.7	2.00	22.1	1.86
Philippines	89.0	1.36	98.9	0.52	64.3	2.67	53.1	2.57	47.8	2.44	5.8	0.69
Sri Lanka	79.1	1.89	91.1	1.55	58.4	2.56	47.6	2.76	21.3	2.40	3.1	0.99
Tunisia	98.3	0.74	98.7	0.68	88.5	1.69	54.6	2.51	21.9	1.97	23.1	1.96
Uruguay	100.0	0.00	99.7	0.30	85.3	1.52	93.4	1.04	93.4	1.00	36.8	1.88
WEI-SPS median	96.6		98.9		87.4		63.9		52.7		22.8	

Source: WEI-SPS database.

Figure 6-Level of School Resources (WEI Cross national Study)

- ✓ Bandwidth constraint
- ✓ Absence of Basic Infrastructure
- ✓ Very high initial setup costs.
- ✓ Developing a trained workforce that is technologically sound.
- ✓ Graphic intense application.

Conclusion -

The challenges education institutions face requires technology that provides efficiencies for staff who are consistently asked to do more with less. Technology purchases that do not come with high returns on investment are not acceptable during these tight fiscal times. Virtualization is the key to lower costs, better manage their IT environments and proactively respond to the needs of students and faculty. At the same time, they are moving towards becoming fiscally and environmentally sustainable. Roughly one-third of campus energy consumption is from technology. So if i can turn off technology, it can make a huge impact in our electrical usage. "Any environment that allows the IT group to do more with less or to do more efficiently with the same amount is always accepted well [8].

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