INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION AND MANAGEMENT

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BOOKS

- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio," Ohio State University.

CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

UNPUBLISHED DISSERTATIONS AND THESES

- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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WEBSITE

- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Economic and Political Weekly, Viewed on July 05, 2011 http://epw.in/user/viewabstract.jsp

VIRTUALIZATION- UNLOCKING HIDDEN CLOUD CAPABILITIES

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ABSTRACT

Virtualization is quickly becoming a vital technology across all parts of the IT environments since last couple of years. Virtualization is now in use across nearly all enterprises, and future plans to move some applications to Cloud Computing, because cloud computing will just compound the problems of virtualization or we can say both technologies are catalyzing each other. The similarities in both strategies are like both helps to reduce the size and control the expansion of data center to reduce the cost of hardware, power and cooling, space, management and disaster recovery but their initial and ongoing costs are differ. This paper aims at addressing some of these doubts about the need for virtualization in a cloud computing context. Our study concentrates on, if virtualization really helps to make the cloud better or both the technologies are making the work of IT industries complex. This paper also focuses on the benefits of using virtualization with cloud computing and its growth rate in the market.

KEYWORDS
Virtualization, Cloud Computing, Data Center.

INTRODUCTION

Many organizations have found themselves drawn towards virtualization and Cloud Computing architectures for their many benefits. Cloud and Virtualization are the hottest topics of IT Industries now a days. Virtualization is a key enabling technology for cloud computing environments. Cloud computing is inclusive of virtualization and a way to implement it. However cloud can be implemented without virtualization as well. Cloud and Virtualization both help deliver optimized resources, on-demand utilization, flexibility and scalability. The concept of cloud computing has captured the concentration and imagination of organizations of all sizes because its service delivery model converts the power of virtualization into measurable business value. Cloud was implemented more of an outsourced/hosted model first and then slowly being adopted within the enterprise firewall as an architecture. Virtualization on the other hand was started within the boundaries of enterprise firewall and then was utilized in hosted environments. Even if there are differences and similarities...many in the industry use them interchangeably.

Virtualization technologies partition hardware and thus provide flexible and scalable computing platforms. Virtual machine techniques (such as VMware, and Xen), offer virtualized IT-infrastructures on demand. Virtual network advances, (such as VPN), support users with a customized network environment to access Cloud resources. Virtualization techniques are the bases of the Cloud computing since they render flexible and scalable hardware services.

Virtualization allows the pooling of the computational power and storage of multiple computers, which can then be shared by multiple users. For example, under the cloud computing paradigm, businesses can lease computer resources from a data center to operate Web sites and interact with customers -- without having to pay for the overhead of buying and maintaining their own IT infrastructures. The virtualization manager, commonly referred to as a "hypervisor," is a type of software that creates "virtual machines" that operate in isolation from one another on a common computer. In other words, the hypervisor allows different operating systems to run in isolation from one another -- even though each of these systems is using computing power and storage capability on the same computer. This is the technique that enables concepts like cloud computing to function.

DEFINITION OF CLOUD COMPUTING

"Cloud computing" is a style of computing where massively scalable IT-related capabilities are provided "as a service" using Internet technologies to multiple external customers. Users move out their data and applications to the remote "Cloud" and then access them in a simple and pervasive way. "Cloud computing" builds upon decades of research in virtualization, distributed computing, "grid computing", utility computing, and, more recently, networking, web and software services [28]. It implies a service oriented architecture, reduced information technology overhead for the end-user, greater flexibility, reduced total cost of ownership, on demand services and many other things.

FUNCTIONAL ASPECTS OF CLOUD COMPUTING

- **Hardware as a Service (HaaS)**

Hardware as a Service was coined possibly in 2006. As the result of rapid advances in hardware virtualization, IT automation and usage metering & pricing, users could buy IT hardware, or even an entire data center, as a pay-as-you-go subscription service. The HaaS is flexible, scalable and manageable to meet your needs. Examples could be found at Amazon EC2, IBM's Blue Cloud project, Nimbus, Eucalyptus and Enomalism.

- **Software as a Service (SaaS)**

Software or an application is hosted as a service and provided to customers across the Internet. This mode eliminates the need to install and run the application on the customer's local computers. SaaS therefore alleviates the customer's burden of software maintenance, and reduces the expense of software purchases by on-demand pricing. An early example of the SaaS is the Application Service Provider (ASP). The ASP approach provides subscriptions to software that is hosted or delivered over the Internet. Microsoft's "Software + Service" shows another example: a combination of local software and Internet services interacting with one another. Google's Chrome browser gives an interesting SaaS scenario: a new desktop could be offered, through which applications can be delivered (either locally or remotely) in addition to the traditional Web browsing experience.

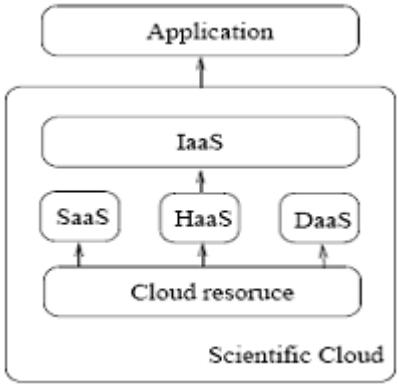
- **Data as a Service (DaaS)**

Data in various formats and from multiple sources could be accessed via services by users on the network. Users could, for example, manipulate the remote data just like operate on a local disk or access the data in a semantic way in the Internet. Amazon Simple Storage Service (S3) provides a simple Web services interface that can be used to store and retrieve, declared by Amazon, any amount of data, at any time, from anywhere on the Web. The DaaS could also be found at some popular IT services, e.g., Google Docs and Adobe Buzzword. ElasticDrive is a distributed remote storage application which allows users to mount a remote storage resource such as Amazon S3 as a local storage device.

- **Infrastructure as a Service (IaaS)**

Infrastructure as a Service is a provision model in which an organization outsources the equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it. The client typically pays on a per-use basis.

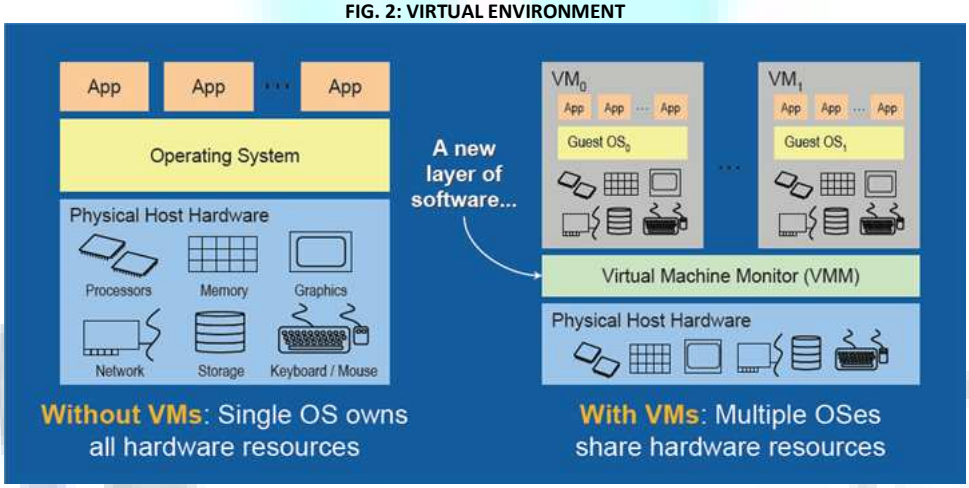
FIG. 1: CLOUD FUNCTIONALITIES



DEFINITION OF VIRTUALIZATION

Virtualization is another very useful concept. It allows abstraction and isolation of lower level functionalities and underlying hardware. This enables portability of higher level functions and sharing and/or aggregation of the physical resources. Virtualization is the creation of a virtual (rather than actual) version of something, such as an operating system, a server, a storage device or network resources. The most common case is to provide customers or users with what appears to be their own system on which they have full root access and control of all services, but without the overhead of maintaining an actual physical machine. A single physical machine can host multiple virtual systems, each of which is granted a slice of its memory, disk space and CPU time. Each virtual system is protected from others on the same host system. Because many applications or customers do not require the full CPU, RAM or disk capacity of a real system, virtualization can be used to safely host several on a single physical system, thus saving resources.

FIG. 2: VIRTUAL ENVIRONMENT



http://connect.in.com/server-virtualization/images-2.html

TYPES OF VIRTUALIZATION

- **Application Virtualization**

Application virtualization is an umbrella term that describes software technologies that improve portability, manageability and compatibility of applications by encapsulating them from the underlying operating system on which they are executed. A fully virtualized application is not installed in the traditional sense, although it is still executed as if it were. The application is fooled at runtime into believing that it is directly interfacing with the original operating system and all the resources managed by it, when in reality it is not. In this context, the term "virtualization" refers to the artifact being encapsulated (application), which is quite different to its meaning in hardware virtualization, where it refers to the artifact being abstracted (physical hardware).

- **Storage Virtualization**

Virtualization is the pooling of physical storage from multiple network storage devices into what appears to be a single storage device that is managed from a central console. Storage virtualization is commonly used in a storage area network (SAN). The management of storage devices can be tedious and time-consuming. Storage virtualization helps the storage administrator perform the tasks of backup, archiving, and recovery more easily, and in less time, by disguising the actual complexity of the SAN.

- **Hardware Virtualization**

This is the most common and is used in IT departments in a company as well as in the data centers. The server's hardware is virtualized thus allowing us to be able to run different OS and different applications simultaneously on the same hardware. This allows us to do server consolidation.

- **Desktop Virtualization**

Desktop virtualization (sometimes called client virtualization), as a concept, separates a personal computer desktop environment from a physical machine using the client–server model of computing.

Virtual desktop infrastructure, sometimes referred to as virtual desktop interface (VDI) is the server computing model enabling desktop virtualization, encompassing the hardware and software systems required to support the virtualized environment.

- **Server Virtualization**

Server virtualization technology makes a single physical server act as many, enabling the use of software in environments separate from the hardware. It allows an organization to get the most out of its hardware, and it provides the flexibility to add and remove virtual servers as needed. Server virtualization technology can be deployed at different levels, including the machine and operating system (OS) levels.

A PERFECT PAIR

Cloud computing is following a similar path as virtualization has over the past several years. Both virtualization and cloud computing saw a spectacular increase in planned tools from 2009 to 2010, with a 15% jump for virtualization management and an enormous 20% jump for the cloud. We've known since 2008 that virtualization and cloud computing were the next wave of technological changes for IT operations [18].

Some say that "cloud computing is virtualization taken to its logical conclusion", but is that really the case? Actually it is cloud who gives a new look to the concept of virtualization. It seems that VMware has taken the growth with the cloud hype. Whether or not you think that virtualization paved the way for the cloud, or that the cloud is just a natural range for virtualization, we think that the two technologies make a perfect match. Efficient real-time monitoring and reporting for virtual environments becomes even more important with the on-demand and self-service nature of the cloud. Some persons say that both the technologies are very complex and confusing but it is also true that without them, IT would not able to move as fast as it is today.

Most of the companies are turning to virtualization and cloud computing technologies to manage their IT infrastructure. Because of that there is an increased need for effective and integrated network monitoring. IT network management will need to adapt and scale for more distributed networks, and avoid "virtual stall".

Virtual stall" is a fairly new phenomenon and, to some, an unfamiliar phrase. To fully understand it, we must first consider the recent history of the modern data centre. Virtualization entered the data centre in a different way than most technologies. Its rapid adoption was driven by the ROI of server consolidation, the flexibility it brings to IT organizations, and in some cases, as a top-down initiative aimed at decreasing the ongoing footprint of the data centre. Virtual stall can occur when enterprise IT is not ready for the rapid growth associated with virtualizing data centers and introducing the cloud. Scalability, management, process and coordination issues are all key factors of virtual stall, mostly due to a lack of automation and reporting in virtualization management tools.

Smaller and more flexible companies haven't experienced VM stall, yet (although they will eventually), and the very large and process-mature organizations generally implemented virtualization initiatives in a more controlled and integrated manner, so they are seeing less VM stall. The firms in between these two extremes, however, need to be concerned about stall.

WHY VIRTUALIZATION WITH CLOUD COMPUTING

Virtualization has three characteristics that make it ideal for cloud computing [30]:

Partitioning: In virtualization, you can use partitioning to support many applications and operating systems (OSes) in a single physical system.

Isolation: Because each virtual machine is isolated, each machine is protected from crashes and viruses in the other machines.

What makes virtualization so important for the cloud is that it decouples the software from the hardware.

Encapsulation: Encapsulation can protect each application so that it doesn't interfere with other applications. Using encapsulation, a virtual machine can be represented (and even stored) as a single file, making it easy to identify and present to other applications.

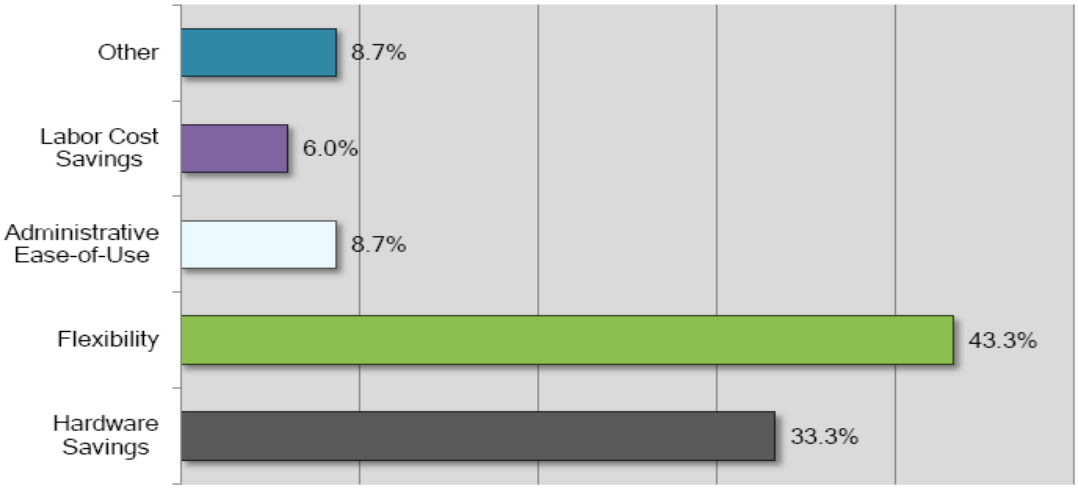
To understand how virtualization helps with cloud computing, you must understand its many forms. In essence, in all cases, a resource actually emulates or imitates another resource. Here are some examples:

- **Virtual memory:** Disks have a lot more space than memory. PCs can use virtual memory to borrow extra memory from the hard disk. Although virtual disks are slower than real memory, if managed right, the substitution works surprisingly well.
- **Software:** There is virtualization software available that can emulate an entire computer, which means 1 computer can perform as though it were actually 20 computers. Using this kind of software you might be able to move from a data center with thousands of servers to one that supports as few as a couple of hundred.

To manage the various aspects of virtualization in cloud computing most companies use hypervisors. Because in cloud computing you need to support many different operating environments, the hypervisor becomes an ideal delivery mechanism by allowing you to show the same application on lots of different systems. Because hypervisors can load multiple operating systems, they are a very practical way of getting things virtualized quickly and efficiently.

According to a survey by Zenoss [13]:

FIG. 3 REASON ENTERPRISE USERS CHOOSE TO USE VIRTUALIZATION



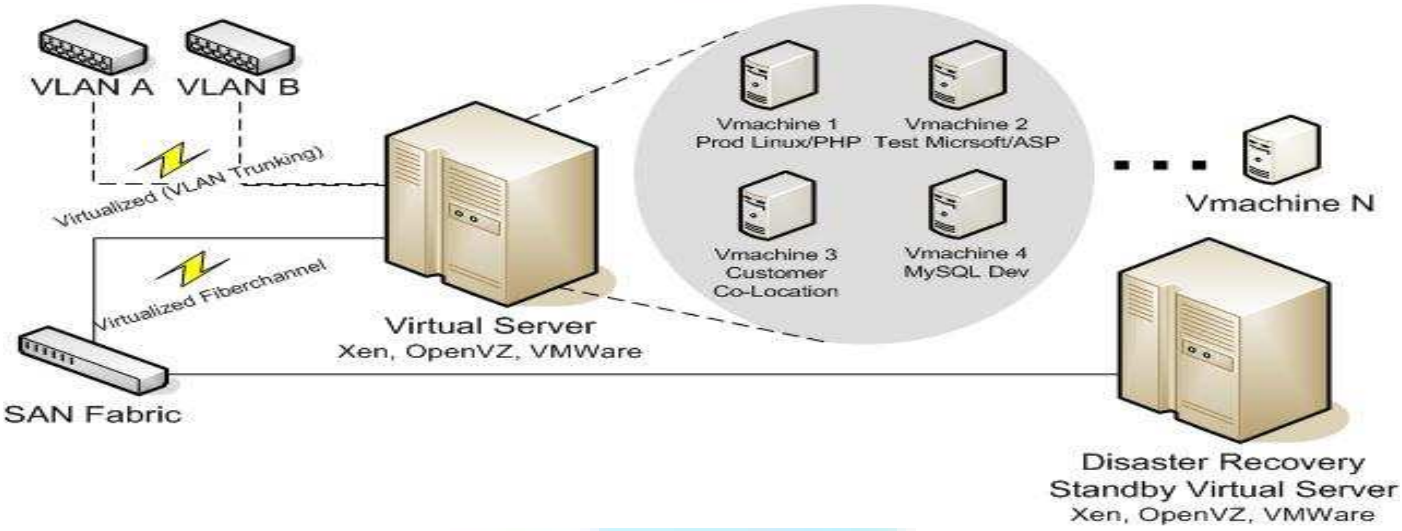
www.zenoss.com/in/virtualization_survey.html apr 13, 2011

EMERGENCE OF A NEW MODEL

Today, most of the IT organisations looking forward with their virtualization initiatives towards the cloud for reducing provisioning cost and strengthening their operations. Some companies started to review their applications, they've realized that many of their applications could easily run in the cloud. So what's the delay in going "P2V" (physical to virtual)? In many cases it crept into organizations, led by developers and technology analysts who recognized the efficiency and cost advantages of virtualization and simply started using it. While many enterprise customers have started expanding their virtual footprints it can be a long and complex process.

Although technically it's quite easy to virtualize an application, using a number of well-known P2V tools such as VMWare Converter from VMware or Platespin (now owned by Novell), the harder part of the process is often agreeing which applications to virtualize and understanding the inter-dependencies between these apps and other data center services.

FIG.4 VIRTUALIZED ARCHITECTURE



Source: http://docs.google.com/viewer?a=v&q=cache:6txmDzFVK8wJ:ciocouncil.iowa.gov/2006_docs/Virtualization.ppt+virtualization+assessment&hl=en&gl=in&pid=bl&srcid=ADGEESgEfXTreg9a95kjzEMQsqqCQeSGk6WlJ3gn8pWDg8iwNrY6CFPbTOQT1iySN1Mz6lGEN3wv7oqLkXMtOZJJ8mjy6iD-naT22y9IEvo4aEYfBPfWbWYbfqUzKf9q6QuQ2adWcwMW&sig=AHIEtbRWAajRBvEHml39YHEQy3tcr748Qw

As corporate IT has slowly adopted virtualization as a strategic imperative, the cloud has come along with paradigm-changing flexibility and elasticity. We're now seeing enterprise customers and prospects ask what they can do with applications that aren't yet virtualized and are still sitting on dedicated servers, recognizing that the cloud is likely to be their ultimate home. Thus we're seeing the emergence of a new model — "P2C" (physical to cloud), with virtualization in the data center becoming a stepping stone to the ultimate destination of the cloud.

STILL VIRTUALIZATION IS GROWING

Although, virtualization is a very old technology, but till now it is very new. Most organizations have adopted virtualization in some way, but are only about 20%-40% virtualized so far. So there's plenty of room left to penetrate, and there's still lots of opportunity for optimization and better management.

The pace of adoption of virtualized servers is incredibly rapid among organizations that are using virtualization, with 35% of servers purchased in 2007 being virtualized and 52% of those bought in 2008 expected to be so. 54% of those not using virtualization expect to do so in the next 18 months. Growth of virtualization as a strategy remains strong, rising from 46% of the base to 54%.

The common wisdom shared by many vendors, analysts, and customers is that "hybrid" environments are key to the emerging IT infrastructure. Some applications will stay behind the firewall and others can be moved to outside cloud environments. Some may need to be split between the data center and external clouds, especially where the database needs to stay inside. In this hybrid world, some enterprises will want to focus on growing the internal virtualization path and starting to build capabilities for provisioning, charge-back, orchestration, role-based access, etc.

BAISED TOWARDS KNOWN TECHNOLOGIES

It is a fact that many enterprise users (as well as some IT departments) have a bias nature towards focusing the cloud revolution on known and existing technologies. It's still a bit difficult to think about moving things outside the data center, and cloud technologies are still in relatively early stages [27]. And external cloud services (in particular public clouds) are pushing the envelope in terms of customer expectations and placing new, challenging demands on virtualization.

But virtualization will have to step up to these demands now that the cloud revolution has raised the bar. Many of the emerging capabilities will need to be at the management plane: a broad range of self-service functions, for sure, but also the ability to route workloads to the appropriate environments based on business and technical requirements, and to federate across multiple and diverse environments both on-premises and externally. The public cloud providers and cloud-enablement vendors are leading the way in these areas. So maybe cloud computing turns out to be not only the logical extension of virtualization, but the catalyst that helps virtualization move to the next level.

MYTHS ABOUT CLOUD COMPUTING AND VIRTUALIZATION

Despite of knowing the benefits of cloud and virtualization, the enterprise users have a lot of myths about both of the technologies [10]. So, in this section we are discussing the general myths about both of the technologies.

LOW COST IS THE CLOUD'S CHIEF ATTRACTION

Low cost is a definite advantage of the cloud, but for many organizations, agility, scalability, time-to-market, and fast access to high-quality infrastructure present more compelling benefits.

THE CLOUD IS ALWAYS LESS EXPENSIVE

That depends on several factors: network and bandwidth requirements, special hardware needs, the cloud service and application that are being considered, and, of course, what you're comparing the cloud to on the other side.

DEPLOYING CLOUD APPLICATIONS IS A SNAP

Most IT organizations will find there's work involved in configuring, deploying, integrating, and managing cloud-based applications. With the right knowledge and tools and the use of best practices, deploying and scaling applications that meet your organization's requirements can be relatively painless.

CLOUD COMPUTING IS FOR SMBS, NOT ENTERPRISES

Larger companies are using the cloud for a variety of applications ranging from highly scalable brand websites to social applications, grid computing for scientific research, media processing, employee collaboration, and a number of other web-based business and consumer services.

THE CLOUD MEANS THERE'S NO ROLE LEFT FOR IT

The cloud in turn can help make IT much more agile and responsive in delivering the applications and capabilities its internal customers require. With fewer IT resources required for the nuts and bolts of infrastructure, IT has more time to spend on the strategic aspect of its role: delivering business value to the organization.

I'LL GET LOCKED IN

This depends on the service you choose. Start by asking the question: What if I need to move? Make sure your contract includes detailed provisions for a fast, smooth exit. Deploy portable cloud configurations that can be migrated quickly from one provider to another. And take advantage of deployment tools that enable quick migration and configuration.

MY DATA WON'T BE SECURE IN THE CLOUD

Public cloud provider security is often better than that of even most large enterprise data centers. Customers should examine contracts and SLAs carefully to ensure that they meet their organizations' data location, control, and security requirements. Sensitive data should be encrypted in transit and at rest.

I WON'T HAVE FULL OWNERSHIP OF MY CLOUD-BASED DATA

You can have full data ownership if you choose your cloud provider carefully and pay attention to contract terms. Data ownership is sometimes an issue with consumer social networking sites, but it is much less likely to be an issue with an infrastructure provider.

CLOUD APPLICATION PERFORMANCE IS HAMPERED BY NETWORK LATENCY AND I/O BOTTLENECKS

Both can be issues, but the degree to which they affect performance depends on your cloud providers, network providers, applications, and cloud deployment architecture. A carefully architected deployment can often avoid these issues.

MY DATA CENTER IS VIRTUALIZED SO I ALREADY HAVE THE CLOUD

Virtualization is a key component of the cloud, but cloud computing is about much more than virtualization. The ability to deploy and scale infrastructure rapidly and programmatically, on-demand, on a pay-as-you-go basis - that's what really defines the cloud and what is difficult if not impossible to achieve using traditional virtualization alone.

VIRTUALIZATION EMERGING AT LIGHT SPEED (STATs)

According to a survey, only about 16% of x86 workloads are running in virtual machines, with an estimated half of all installed workloads to run in virtual machines by YE2012[20]. Perhaps not so surprisingly, the engine of growth for virtualization is switching from large enterprises to small business. Large enterprises started sooner and are perhaps 25% virtualized today.

Virtual Machines: % of installed x86 workloads running in a vm

- 12% 2008
- 29% 2009
- 48% 2012

Market Share – Virtual Machine installed base and growth projections

- VMware owned 89% of 5.8 million installed virtual machines in 2008
- Microsoft had 8% of the installed market (Virtual Server more than Hyper-V installations)
- Citrix had only 2%

By 2012, the installed base of virtual machines is projected to reach 58 million with market share as follows: VMware 65%, Microsoft 27%, Citrix 6%.

AUDIENCE POLLS

What is the primary vm solution you are using for x86 servers now?

- Citrix 3%
- Microsoft 7%
- Novell 0%
- Oracle 1%
- Red Hat 1%
- VMware 85%
- Other 3%

What will be your primary virtual machine solution by 2012? (i.e., how many of you are going to leave VMware and for what other solution)

- Citrix 5%
- Microsoft 21%
- Novell 0%
- Oracle 3%
- Red Hat 5%
- VMware 65%
- Other 1%

So Virtualization has a smaller growth rate till now but don't feel bad for that since it is supposed to get 10x bigger upto 2014.

WE'RE NOT DONE YET

According to experts, when virtualization technology first emerges, many business managers viewed it with suspicion. They saw the removal of the physical servers on which key applications ran as worrisome. This has changed over time, as many have recognized the operational and financial benefits of virtualization. But virtualization is one step toward a larger goal, not the end of the journey. IT is in the middle of a fundamental transition from the rigid, siloed world of traditional data centers toward a more elastic, responsive model where needs are met far faster and more efficiently. And we're not done yet. While virtualization helps companies reduce cost and improve agility, the full promise of the new model plays out with the addition of cloud computing, delivering infrastructure on demand as an easily-accessible, cost-effective service.

The new model will allow companies to get out of the computing infrastructure business where appropriate, retaining only the portion that is essential to the enterprise. As the cloud environment becomes increasingly agile and secure, provisioning decisions will be framed by asking: Should we be really be doing this ourselves, or can someone else do it better and at lower cost?

Virtualization can make IT more responsive to the needs of business. Without spending lots of weeks to provision a physical server a virtual server can be stalled in few minutes. While virtualization brings much needed flexibility and efficiency but virtualization alone cannot solve several problems of IT industries. The

reason behind that is IT companies still have huge data infrastructure to maintain. The real improvement comes when virtualization combined with the cloud capabilities. While virtualization is a key step toward moving beyond the rigid data center, cloud computing takes you all the way there - which is why it's getting so much attention.

CONCLUISON

"Cloud" computing stands on decades of research in virtualization, distributed computing, utility computing, and, more recently, networking, web and software services. It implies a service-oriented architecture, reduced information technology overhead for the end-user, great flexibility, reduced total cost of ownership, ondemand services and many other things. This paper discusses the concept of "cloud" computing with the virtualization technology. Recent cloud solutions are heavily based on core Virtualization technologies e.g. VM provisioning, VM Migration etc. Virtual environments and cloud computing both cut data center budgets by reducing the number of servers required, power and cooling costs, floor space requirements, management overhead, and disaster recovery expenses. The vision and potential of cloud-based virtualization is very real. So, the innovation will continue and there will be massive value created for customers over the next two to three years. However, both the technologies are emerging one that's why the speed of adoption is slow. According to a survey, 23% of installed applications are running in a VM now. 48% of installed applications will run on a VM by 2012.

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