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Cloud and Virtualization: Interdependency

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Abstract: ***Cloud Computing and Virtualization are two booming technologies in this era. This paper is an attempt to correlate cloud with virtualization. This paper represents cloud as 'automated virtualization' and 'how virtualization is a necessity to implement cloud' is the main concern of paper.***

Cloud comes with business need in any IT organization to manage business cost and faster availability of required infrastructure. It comes by implementing defined processes and services to meet the increasing demand by business to reduce time of availability.

Cloud computing is inclusive of virtualization and a way to implement it. While it is not uncommon to discuss them interchangeably; they are different approaches to solve the problem of maximizing the use of available resources. They differ in many ways and that also leads to some important considerations when selecting both or between the two. While understanding these technologies separately, we found that somewhere these technologies cannot be separated from each other. When we implement cloud, Virtualization is the technology which works as the right hand and is difficult to avoid. So, it will not wrong if we say that both of these technologies complement each other.

Keywords: cloud, server, virtualization, automation**.**

1. Introduction

In this paper we are correlating Cloud and virtualization. So, basic understanding of these both technologies is must, which we are discussing under Key Technologies. After discussing the basic properties of these technologies we are trying to find out how they are similar to each other and how they differentiates ,which are the points that make them complementary of each other. The main concern of paper is to illustrate the unavoidable use of virtualization in cloud.

2. Key Technologies

2.1 Cloud Computing

Cloud computing grew out of the concept of utility computing. 'Utility computing' is the belief that computing resources and hardware would become a commodity to the point that companies would purchase these resources from a central pool and pay only for the amount of CPU cycles, RAM, storage and bandwidth that they used [2]. These resources would be metered to allow a pay for what you use model much like you buy electricity from the electric company. This is how it became known as utility computing.

'Cloud computing is the name for the whole end to end package provided for a customer who wants to outsource their software, platform or infrastructure to someone , who could provide these 'as a service'. Service providers provide customers a way to access those services in a secure, accountable, reliable, scalable, monitored manner, usually on a pay per use basis [1]. " Cloud" means that things are hidden behind the scenes i.e. they are not transparent or they are cloudy- it is a form of abstraction - so all the customers know is that they get the service they need on demand, but they don't know the details of how it is being done.

It is common for cloud computing to be distributed across many dedicated servers. This provides redundancy, high availability and even geographic redundancy. This also makes cloud computing very flexible. It is easy to add resources to your application. [5]. Cloud computing has been designed with scalability in mind.

2.2 Automation of Cloud

The concept of cloud computing has captured the attention and imagination of organizations of all sizes .There are many other technical elements to deploying a Cloud environment.

It is a service delivery model that converts the power of virtualization into measurable business value by adding the provisioning and billing capabilities. Automated self-provisioning aspect has make Clouds run [4]. Metering and billing is important to monetize or chargeback costs. Automation is all about monitoring the services provided by Cloud to the customer. It is more over same as our electricity meter. All the services like software, platform or infrastructure are monitored and then bill is generated accordingly. So, automation of services is as much important as a measuring device of a retailer while selling sugar [8]. Automation has reduced human involvement while speeding up the time it takes to bring new resources. Cloud services are automated by different automation software's to enable service distribution and billing customer run smoothly.

2.3 Virtualization

Virtualization is an under the cover technology that decouples physical infrastructure from the service provided. It is a core

enabler of cloud computing [8], because the services must be abstracted in order to allow communication and control through a Web service. e.g., start a php server at the URL www.myphpserver.com. Virtualization is a layer of software that lets companies consolidates several of their in-house servers onto a single piece of hardware.

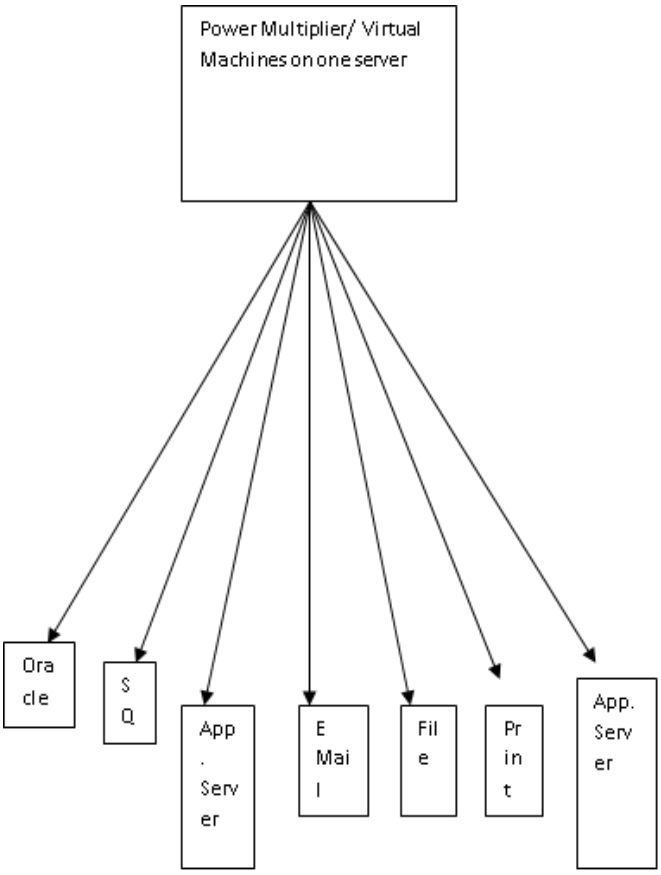

Figure 1: Virtualization Model

This virtualization model clears what exactly the virtualization is. It is actually a power multiplier which converts one server into multiple providing multiple ends to use it for different purposes and by different vendors. Virtualization is a technique that allows you to run more than one server on the same hardware. Typically one server is the host server and controls the access to the physical server's resources. One or more virtual servers then run within containers provided by the host server.

The container is transparent to the virtual server. So, operating system does not need to be aware of the virtual environment [1]. This allows server to be consolidated which reduces hardware costs. Less physical servers also means less power, cooling and space which further reduces cost.

3. Cloud and Virtualization: Correlation

After explaining what cloud and virtualization is. We come to main agenda of this paper that is how cloud and virtualization are complementing each other in industry. For that first of all we lighten up their differences and similarities. After that we will have a glance at how virtualization is enhancing cloud and vice versa. Even if there are differences and similarities in cloud and virtualization technologies, many in the industry use them interchangeably. Following is the discussion, based on different criteria for both Technologies.

(a) Technology based: While virtualization may be used to provide cloud computing, cloud computing is quite different from virtualization. However, cloud computing can be better described as a service where virtualization is part of a physical infrastructure. Cloud computing may look like virtualization because it appears that your application is running on a virtual server detached from any connection to a single physical host [1]. E.g. the cloud vendor who is proving services has a single server and this server is virtualized in multiple.

(b) Cost based: As we know cloud provides all the IT services and companies get rid of the cost of establishing own data center. On the cloud vendor end virtualization further reduces cost of multiple servers by virtualization. So both cloud and virtualization are drastic cost efficient services. Virtualization is a technology that can increase efficiency in your data center and which might be leveraged by cloud providers as well. It can reduce the costs of hosting all your old stacks in the short term [10]. Cloud on the other hand is a disruptive shift in the value proposition of IT and the start of a prolonged disruption in the nature and purpose of businesses.

(c) Architecture based: In essence cloud will enable organizations to share multi-tenant business capabilities over the network in order to specialize on their core value. Whilst virtualization can help you improve your legacy mess it does nothing significant to help you take advantage of the larger disruption as it just reduces the costs of hosting applications that are going to increasingly be unfit for purpose due to their architecture rather than their infrastructure [11].

3.1 Differences

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 [13].

Areas of differentiation may be the following:

(a) Granular billing/chargeback: An automated cloud provides some billing system on monthly bases for charging the consumer for the services being used. This is not applicable for virtualization.

(b) APIs. : Cloud computing has some well-designed user application interfaces for purchasing services from the cloud. Virtualization does not need any APIs.

(c) Saving money: How do you decide whether you need virtualization or cloud computing? They both can save money but they do it in different ways. One key consideration is when you need to save the money. If you use virtualization, you will have a great deal of upfront cost. A new application will need servers and you'll have to purchase the infrastructure for it. Virtualization means you'll be spending high upfront and you will save money over time, but there is still going to be a large amount of capital spent early on. Cloud computing works in just the opposite fashion. Your new application may not need many resources initially so cloud computing will likely cost

very little in the beginning [2]. However, as your application becomes popular and uses more resources, paying by the resource may become more expensive than using virtual servers on your own infrastructure.

3.2 Similarities

(a) Cloud and Virtualization both help deliver optimized resources, on-demand utilization, flexibility and scalability [1].

(b) Cloud Computing and Virtualization both were developed to maximize the use of computing resources while reducing the cost of those resources. They are also mentioned frequently when discussing high availability and redundancy.

4. Virtualization - 'Engine behind Cloud'

Virtualization enhances the environment of cloud in respect of output achieved. Cloud provides resources to the customer and for maximum utilization of these resources virtualization is used.
Following diagram illustrate use of virtualization in cloud use environment.

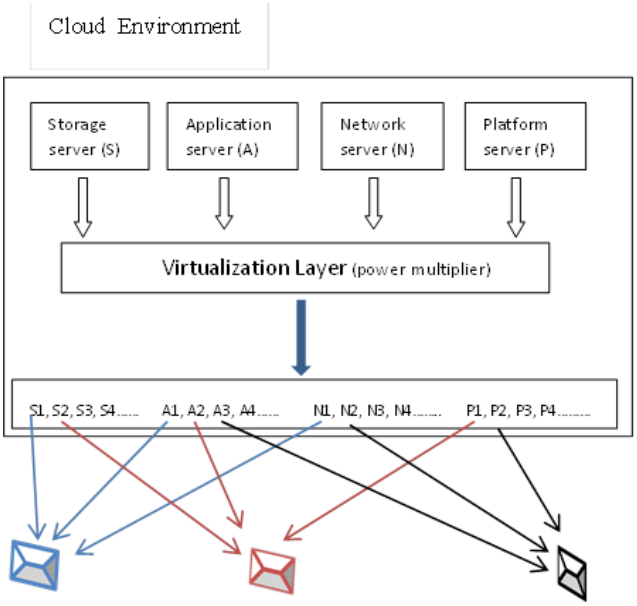

Figure 2: Virtualization in cloud Environment

In this illustration the services provided by the cloud vendor are Storage (S), Applications (A), Network (N), and Platform (P).
Providers for these services are limited and customers are many. Now by virtualizing the resources we create virtual servers/machines and allocate them to different customers [13]. For example in Fig 2 Storage is virtualized as S1, S2, S3…..virtual points and these points are allocated to different customers. Same is the case with A, N and P … Witch are virtualized as A1, A2, A3…..N1, N2, N3…. P1, P2, P3…..etc.
So this is how virtualization is enhancing Cloud performance whether it's a private or public cloud. Virtualization is a key enabling technology for cloud computing environments. Certainly virtualization enables a more efficient utilization of existing computing resources [1]. To take this thinking up a notch, cloud, in all its forms, represents a "virtualization" of resources, be it physical infrastructure, applications, or data. In this way both key technologies that are cloud and virtualization complementing each other for getting best results and maximum output.

4.1 Cloud as an ' Automated Virtualization'

Now it's clear that virtualization not only enhances cloud services but is an unavoidable part of it. In another way cloud as a whole can be considered as 'automated virtualization'. The term automated virtualization can be understood as

Virtualization + automation = Cloud

Virtualization is the stepping stone to cloud computing. Physical and logical resources are made available through a virtual service layer across the enterprise. Virtualization process is automated using some automation software and attached to cloud to fulfill requirements of customer.

4.2 Benefits of using cloud, Automation and Virtualization together

(a) Cloud enables IT organization reduce their time to market by defining processes and making the infrastructure readily available that is based on virtualization technology in an automated way.
(b) Cloud also enables IT organization to use these automated processes charge back respective teams in organization based on their usage of resources for particular time only and enable IT better manage ROI and cost.
(c) Virtualization, which not only increases the utilization of machines and reduces the number of physical devices the company runs, but also makes speeds up IT operations.
(d) As Service-oriented architectures (SOA) break up an application into distinct, pluggable services like storage, messaging, and authentication, making them easier to diagnose and upgrade independently.
(e) Automation, which reduces human involvement (and human error) while speeding up the time it takes to bring new resources online.
(f) Scaling horizontally, by avoiding the use of joins in databases and other storage approaches [3]
(g) The choice of moving to the cloud may be one for the business based on cost, or maybe even put forward by IT, but at no point does the cloud provider's implementation affect the business model of customer moving to the cloud.

4.3 Limitations

This combination is often referred to as the basis of private clouds, but it doesn't take into consideration the economic benefits of public cloud, burst capacity and removes a lot of the heavy lifting with regards to operations and support.

5. Overall Effects of virtualization on IT Environment

Virtualization technology has enabled increasing the utilization rate, scalability and flexibility of their servers in different IT environments. Virtualization has following effects on data center physical infrastructure (DCPI)[6].

5.1 Creation of more high-density areas and hot spots

Virtualization enables organizations to achieve server consolidation ratios of 10:1, 20:1 or even higher. It results in higher CPU utilization rates on the remaining physical hosts. As a result, those hosts draw more power and tend to get grouped together in ways that create localized high-density areas and hot spots.

To deal with this with this scenario,

(a) Spreading out the high-density equipment throughout the data center.
(b) Consolidating high-density systems into a pod with dedicated cooling and/or an air containment system.

5.2 Dynamic IT load swings

One of the benefits of virtualization technology is the ability to shift loads dynamically from one server to another as per requirement. But this sudden, increasingly automated creation and movement of virtual machines requires careful management and policies that take into account. Failure to do so could undermine the software fault-tolerance that virtualization brings to cloud computing.

To deal with this with this scenario,

(a) Data center infrastructure management (DCIM) software can monitor and report on the health and capacity status of the power and cooling systems, and keep track of all the relationships between the IT gear and the physical infrastructure to ensure IT loads aren't moved to areas that can't handle them.

5.3 Lowered Redundancy Requirements

One of the lesser-known benefits of server virtualization is, it can lead to a reduced need for redundancy in the physical infrastructure. With the ability to dynamically shift loads, a well-managed virtual server implementation brings with it a high degree of fault-tolerance for both the servers and the applications that run on them. Workloads, entire virtual machines, and virtualized storage resources can be automatically and instantly relocated to safe areas of the network when problems arise.

This level of fault tolerance may reduce the need for a highly redundant (i.e., 2N or 2N+1) power and cooling system in a highly virtualized data center. If, for example, the failure of a particular UPS does not result in business disruption, it may not be necessary to have a backup, redundant UPS system for the one that failed. In this way companies can save money in various scenarios, depending on their requirements and server configuration.

5.4 Detrimental effect on power usage effectiveness (PUE)

Even though high-density servers may draw more power than those they replaced. It may seem non-intuitive, then, that the data center's PUE rating can actually get worse after a virtualization and server consolidation project[6] The reason, is what's known as "fixed losses," which is the power consumed by power and cooling systems regardless of what the IT load is. As the IT load shrinks, these fixed losses will become a greater percentage of the overall data center energy use – which means PUE will worsen.

To deal with this scenario,

There are multiple options for optimizing the power and cooling infrastructure after a server consolidation, to get it the aligned with the new, lower IT load. Which results in a much lower electric bill.

6. Conclusion and Future work

The conclusion of this paper is very much clear that virtualization and cloud are two different technologies, while virtualization can be implemented independently Cloud have a dependency on virtualization and can't be implemented alone. Purpose of both is to save cost, maximize utilization of resources and faster provisioning, so when we use them together we achieve this goal efficiently [1]. In this way Virtualization and Cloud becomes adjacent and complementary technologies, but not alternatives to each other. Virtualization and cloud computing are both ways to reduce infrastructure cost by maximizing the utilization of computing resources. They are not the same thing however. Virtualization allows server consolidation by hosting many servers on a single piece of hardware where cloud computing is a service that delivers computer resources on a metered pay-as-you-go model. While they both have advantages, you'll want to think about factors like startup cost versus long term costs and the possible loss of control of your infrastructure when deciding which model to utilize.

For the next three or four years, enterprises will deploy private and hybrid clouds, putting millions into the coffers of consulting companies and business process outsourcers. There will be great savings, and rejoicing. Public cloud infrastructure will be reserved for startups, experimentation, testing, massively parallel tasks (such as genomics, data warehouse analytics, or Monte Carlo simulations) and other burst, not-private work [3].

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