



ROLE OF VIRTUALIZATION IN CLOUD COMPUTING

Prof. Vishwakarma B.M.

Asst. Prof. D. G. Tatkare Mahavidyalay, Mangaon-Raigad

Abstract

The virtualization technology (server, network and storage virtualization technologies) is not a new concept in hardware and software development, it used for developing new concepts like cloud computing technology in an IT global application.

Keywords: *Cloud Computing; Virtualization technology; Server Virtualization; Network Virtualization; Storage Virtualization.*



Scholarly Research Journal's is licensed Based on a work at www.srjis.com

1-INTRODUCTION:

In these days all the software developers are creating packages based on the cloud computing technology, and for cloud providers, it is a good opportunity to use strobe bond systems with low cost. Cloud computing is an internet based computing with the ability to share resources (hardware, software, storage, network) on -demand and dynamically, but most of the IT people do not pay attention to one point and it is the evolution of cloud computing could not be possible without existing of other technologies like virtualization technology.

We can see the footprint of virtualization technology in most of the major abilities which provides by cloud computing technology. In this article we attempt to understand what virtualization is, what is the relation between virtualization and cloud computing and at the end where virtualization can stand in cloud computing concept.

2- HISTORY OF SERVER VIRTUALIZATION

In the 1960's, when the data center technicians had problems with traditional data centers (static data centers), the dynamic solution was the solution to their problems.

The major problem was very simple, if they had high load on their data center occasionally, they could not manage it easily, hence the greatest achievement was the new technology called as server virtualization.

The data centers service providers reached to the ability of controlling their resources as they needed and when they needed. This controlling ability gave them that idea which they can share this ability with other organization if they pay for that. The idea was the starting of creation of the cloud computing concept.

With the help of virtualization technology, we can easily create different virtual machines (not physically) and share all available resources between these virtual machines. Each virtual machine can have its own resources based on the duty which defined for it.

3-Virtual Machine

If we want to define virtual a machine simply as we stated before there are isolated boxes which shared hardware between them. These boxes are carefully separated to each other and act like different physical computers, which can be connected via same network or not.

“A virtual machine (VM) is an abstraction layer or the environment between hardware components and the end-user.” Virtual machines have an ability to run any operating systems on them and in special cases it referred to as virtual hosts.

The interaction between the guest operating systems which are running in virtual machines (VM’s) and resources which are available for sharing between virtual machines, provided in two ways. One is by using the host operating system, or another, a piece of software which called as the hypervisor and acts like mini operating system, can run many virtual machines. Hypervisor also call as virtual machine monitors (VMM). They are able to share system hardware components such as CPUs, controllers, disk, memory, and I/O among virtual servers.

4- HYPERVISORS

In virtualization technology, there is one piece of software that allows the physical servers can have multiple instances of virtual machines and it called as Hypervisor.

These instances are virtual machines that create in virtualization environment and the hypervisor is responsible for supervising and controlling these machines o communication, resource sharing and reallocating the virtual machines.

This connection between virtual parts and physical parts is very important in a cloud

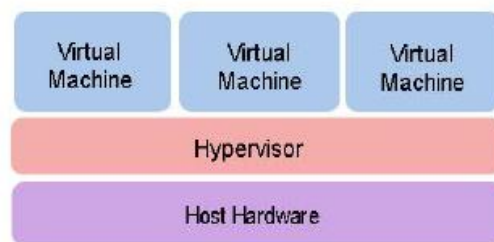


Figure 1: Hardware virtual machines

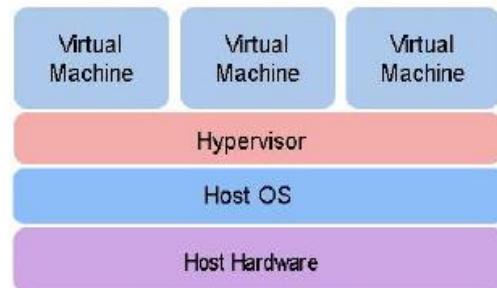


Figure 2: Software virtual machines

computing environment and it is the only path to the dynamic data centers which was our solution for new data centers.

There are two types of hypervisor. The first is called as “Bare Metal Hypervisor” and the second one is called as “Hosted Hypervisor”.

The first type is directly installs on the hardware and controls all the resources. The hypervisor shares resources among the virtual machines and divided them as the policies are defining it.

Our focus is on the type one hypervisor that used for data centers. A hypervisor or virtual machine manager (VMM) is a piece of software which we can install it on hardware to allow us to use multiple operating system on hardware (type one). When we talk about the high availability of cloud computing and moving instances (VM’s) between the servers, we must know that the virtualization has a major role in this ability of cloud computing.

This piece of software actually controls the all incoming and outgoing actions and it is a connector between hardware layer and virtual machines.

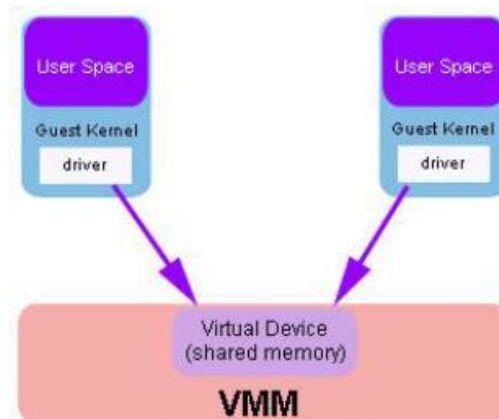


Figure 4: Z/VM Architecture [13]

5- VIRTUALIZATION AND CLOUD COMPUTING

One of the principal questions in this concept is: “are virtualization and cloud computing same?” The answer for this question is “No”. The virtualization is the ace of the layers in cloud computing architecture, but it has a major role in most of the abilities of cloud systems. Virtualization is one of the technologies that given the ability to create the abstraction of computer with ability to perform all the behavior of the actual computer. With the aid of these concepts, we can create other new technologies and one of them is cloud computing technology.

But we can say these two concepts are closely related to each other. The virtualization is an overall concept that holds lots of abilities for creating a computers or computer groups virtually and make network of these virtual computers.

With the help of all these facilities that virtualization provided for us, computer scientists took advantage of that and with few changes and controllers developed the cloud computing technology.

6- PLACE OF VIRTUALIZATION IN CLOUD COMPUTING

Virtualization is one of the major components of cloud computing that helps to emergence of cloud computing. To understand cloud computing it is important to understand the concepts like network virtualization or storage virtualization.

The main components of virtualization in the cloud are virtual machines, because all of the operating systems and applications are inside them. They are like a container which isolated and separated from each other, even in the same physical host.

Based on the basic role of cloud as-pay-you-go, the vendors give you that ability to access these provided virtual machines and in some cases they will make these virtual machines like an actual computer and you can purchase them for a limited time and take advantage of this ability without any worries about how they operate. That thing you are purchasing is the availability of these services. Vendors in exchange promise to give you these services without any interrupt that make the availability in high level.

7- HIGH AVAILABILITY CONCEPT OF CLOUD

We should know how we can achieve the “high availability” in the cloud concept. As stated before, all the machines we are using here is virtual, it means they are pieces of software that easily we can copy them whenever and anywhere we want. So if any trouble happens to our physical servers or related devices, we can easily move the virtual machines to a new location. It means the virtual machines easily can move across our data center to avoid downtime of the service which that particular virtual machine will provide.

Actually, in this case even we do not need to do that, as we know the new servers which used for virtualized data centers, do not have any physical storage that directly attached to the servers and they just do the processing part of all jobs. So if one server failed, we can use the other servers to do processing jobs.

8- SCALABILITY OF CLOUD

Scalability of cloud also is one of the achievements which its existence because of virtualization. The dynamic attribute of the virtualization is helping the cloud providers that offer such an environment that any request can respond on-demand.

In cloud computation process, if any of virtual machines need to increase one of the resources, it can be increased by the cloud management system. Even if a user needed to

increase any of the resources, as service level agreement, the cloud management system can manage these resources and user environment can be expanded.

9- NETWORK VIRTUALIZATION

In the old days the data center technicians need to go through in the hard work of cabling, but nowadays by help of virtualization the cables are gone (of course not entirely). Instead of physical connection between two physical computers, we can virtually connect two of virtual computers together. By help if virtualization even cables converted to the virtual cables and it reduced the time which the data center technicians spend on the cabling and maintaining the cables.

The cloud computing systems are essentially using the TCP/IP based protocols on communication. It is like communication in LAN networks. Each computer has one specific, unique IP and they are communicating with each other.

Network virtualization also continues the term of scalability in a cloud environment. The important point also here is a dynamic scalability of network resources. In cloud network communication, the physical devices will connect via the physical connection and they can communicate with their physical NIC's, but virtual devices use the virtual NIC's which is distributed within hosts.

If two VMs want to communicate to each other through a network, there are two scenarios. The first scenario is communication between two VM on a same physical host. In this case all devices will be virtualized devices like virtual switches or virtual firewalls. As shown in the figure, the base communication will be through a hypervisor.

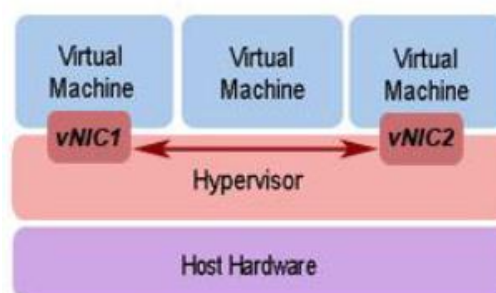


Figure 5: VMs communication on one a physical host.

In the second scenario, two VMs are on different physical host which communication is a combination of physical communication and virtual communication. As shown in the figure, the virtual NIC will be linked to the physical NIC of host one. After that the communication will be between physical NICs and at the last step, the packets will send to another virtual NIC.

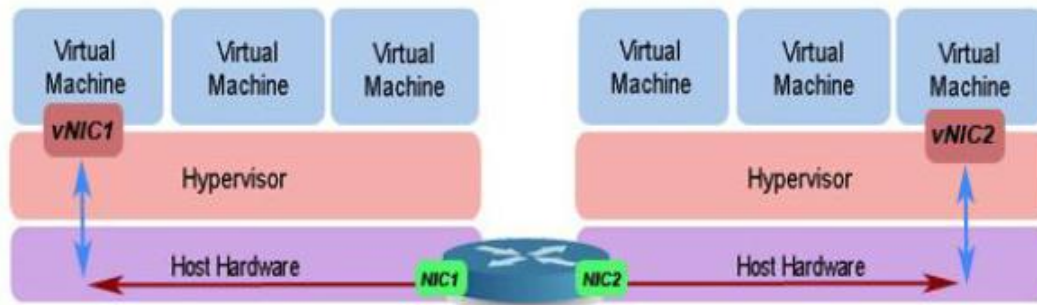


Figure 6: VMs communication on two physical hosts.

But, still there are some difficulties in this environment. One the challenges in the virtualized environment is about the IPs. As mentioned before, the IP of each VM comes from the pool of IPs. In a life cycle of a VM, the assigned IP will be selected from the pool of IPs and after the completion of the life; the assigned IP will be released. The problem will arise within the VM migration process.

10. STORAGE VIRTUALIZATION

In data centers the data storage is little different. The physical storages are not directly connected to the servers; they are connected to the servers through the network. One of the most popular protocols use for storage virtualization is a storage area network (SAN) and network attached storage (NAS). For the fast interaction the use fiber channel and the protocol they are using is iSCSI (internet Small Computer System Interface). These protocols allow block storage to be accessible over the network by using a TCP/IP protocol. They use TCP for reliable communication.

The storage virtualization also relies on a Redundant Array of Independent Disk (RAID) technology to protect data from lost in any physical failure occurs. In new virtual storage systems, they use the latest technology which called as Redundant Array of Independent Node (RAIN) rather than RAID. This new technology helps availability of data even if several servers go down.

11. MEMORY VIRTUALIZATION

In virtualization concept also we have a virtual memory environment. The guest operating systems that loaded into different virtual machines, using virtual addresses and these addresses will mapped into the physical memory addresses. But guest operating systems can not directly access to the actual physical memory and responsible for controlling of this operation is a hypervisor.

VMs are using the virtual memories based on the paging techniques. In reality, there are three different types of memory we can enumerate here. One is used by the guest OS, we can call it

as virtual memory. Another memory is addressed in the hypervisor and we can call it as real memory and the last one is the physical memory.

12. VIRTUALIZATION AND CLOUD SERVICES

With the help of virtualizing and creating user access policies, cloud computing services can be provided by cloud vendors. If a user needs a SaaS as service, vendors gave permission to the user to access to just software level and the rest of the layers, software based or hardware based, is supported and manages by cloud providers. Likewise, if you need PaaS or IaaS services, the provider gives the permission to access more layers involves in cloud computing systems.

13. CONCLUSION

In new computer technologies, we cannot push the one concept back and highlight the other one. All concepts in the computer world are intertwined together; we should not break them apart and discuss them individually. In this case by pushing the important concept of virtualization, we broke down the evolutionary chain between of technologies in the computer world and make the confusion. Without understanding the concept of virtualization, it is very difficult to realize the cloud computing concept.

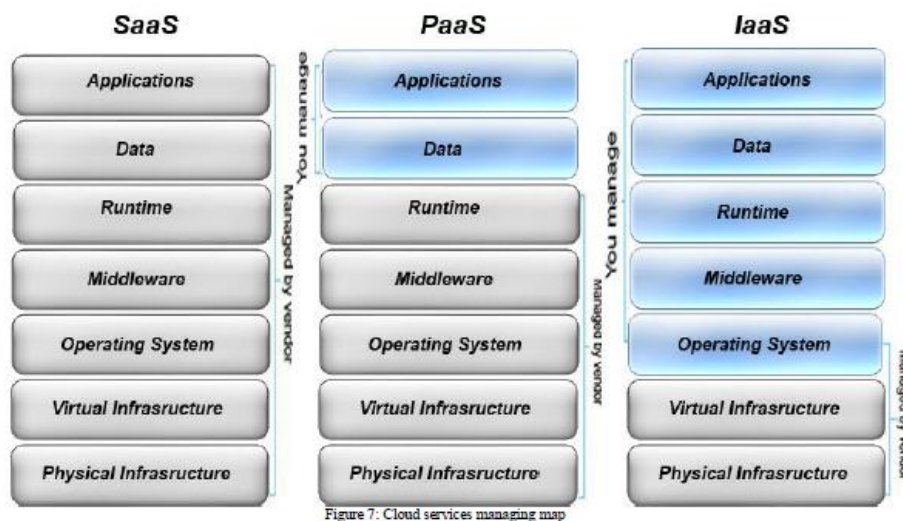


Figure 7: Cloud services managing map

References

- N. Leavitt, "Is Cloud Computing Really Ready for Prime Time?," *Computer*, Vol. 42, p. 15-20, 2009.
- M. Varian, "VM and the VM community: Past, present, and future", *Office of Computing and Information Technology, Princeton, University, Princeton, NJ*, 1997.
- D. Kreuter, "Where server virtualization was born", *Virtual Strategy Magazine*, July 2004.
- M. Armbrust, A. Fox, R. Griffith, A.D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, M. Zaharia, "A View of Cloud Computing, *Communications of the ACM*," Vol. 53 No. 4, Pages 50-58, April 2010.
- D. CHISNALL, "The Definitive Guide to the Xen Hypervisor", 1st ed. Prentice Hall Open Source Software Development Series, 2008.

- Jinho Hwang, Sai Zeng, Frederick y Wu, and Timothy Wood, "A Component-Based Performance Comparison of Four Hypervisors," 13th IFIP/IEEE International Symposium on Integrated Network Management (IM) Technical Session, 2013.
- J. Daniels, "Server Virtualization Architecture and Implementation", *Crossroads*, Vol. 16, No.1, Fall 2009.
- P. Barham, B. Dragovic, K. Fraser, S. Hand, T. Harris, A. Ho, R. Neugebauer, I. Pratt, A. Warfield, *Xen and the art of virtualization*, in: *Proc. 19th ACM Symposium on Operating Systems Principles, SOSP2003, Bolton Landing, USA, Oct.2003*.
- H. Eiraku, Y. Shinjo, C. Pu, Y. Koh, K. Kato, "Fast Networking with Socket Outsourcing in Hosted Virtual Machine Environments". In *Proceedings of the 24th ACM Symposium on Applied Computing*, 2009.
- X. Zhang, S. McIntosh, P. Rohatgi, J. L. Griffin. "XenSocket: A high-throughput interdomain transport for virtual machines" *Proc. ACM/IFIP/USENIX 8th Int'l Middleware Conf.(Middleware '07)*, pp. 184-203, November 2007.
- K. Kim, C. Kim, S. I. Jung, H. S. Shin, J. S. Kim. "Inter-domain Socket Communications Supporting High Performance and Full Binary Compatibility on Xen," *Proc. Int'l Conf. Virtual execution environments (VEE '08)*. pp.11-20, March 2008.
- J. Wang, K. Wright, and K. Gopalan, *XenLoop : A Transparent High Performance Inter-VM Network Loopback*, *Proc. of International Symposium on High Performance Distributed Computing (HPDC)*, Boston, MA, June 2008.
- H.R. Mohebbi, O. Kashef, M. Sharifi, "Zivm: A zero-copy inter-vm communication mechanism for cloud computing", *Computer and Information Science*, Vol. 4, No. 6 p18, November 2011.
- M.F. Mergen, V. Uhlig, O. Krieger, J. Xenidis, "Virtualization for high-performance computing," *ACM SIGOPS Operating Systems Review*, Volume 40 Issue 2, p 8 – 11, April 2006.
- N. M. M. K. Chowdhury and R. Boutaba, "A survey of network virtualization", *Computer Networks* , 54(5):862-876, 2010.