Virtual Machines

TJ Cloud Computing Club

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1 Introduction

A standard computer by itself is very useful, but is also fairly limited. One major disadvantage is that you can only use one operating system (whether it be Mac OS, Linux, or Windows). Additionally, running several applications at the same time usually creates conflicts, and software and hardware are very tightly coupled. In businesses especially, this proves to be a big problem. Companies would have to buy multiple servers for each of their processes. How do we solve this problem? Cloud computing.

Virtual machines are essentially software computers that have the same functionality as physical computers. With these machines, you can have multiple operating systems and multiple applications running on one server at the same time. This greatly increases the efficiency of machines and allows more flexibility of hardware. Virtualization is the process of creating a virtual machine in a server.

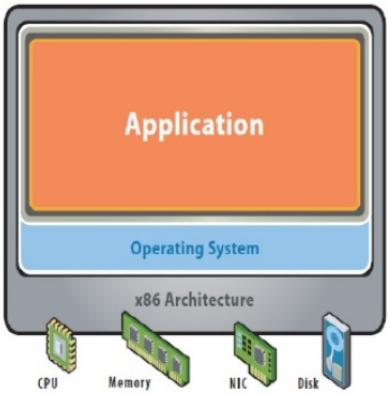


Figure 1: Before Virtualization

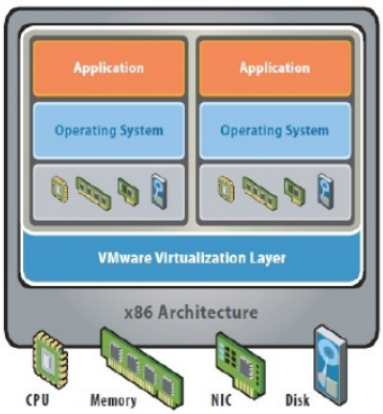


Figure 2: After Virtualization

2 Key Features of Virtualization

- Partitioning: As previously stated, virtual machines can allow multiple operating systems to run on one physical machine. Each system resource can then be divided between each virtual machine.
- Itemization: Virtualization also allows for isolation of different processes. One large benefit is that security can be maintained on a dedicated application to protect the server from malware, viruses, and other harmful applications.
- Encapsulation: The complete status of a virtual machine can also be stored in one file. This allows for virtual machines to be moved and copied as easily as regular files.

3 Benefits to VMs in the Cloud

- Compute - Virtual machines in the cloud provide you with a whole new computer, complete with its own compute power. If you want to run anything that is computationally labor-intensive without taxing your own machine, cloud VMs are the way to go
- Storage - Although there are better, more specific, optinons if all you are looking for is storage, cloud VMs allow you more control and more features bundled with the extra storage
- Reliability - With public cloud providers constantly monitoring and protecting your VM, you never have to worry about it crashing or you losing your data. No matter the processes you are running on the VM, it will always be there.
- Public - Public access allows for great sharing and multi-tasking. It also allows for web server hosting so that anyone in the world can access your website!

4 Virtual Machines in AWS, Azure, and GCP

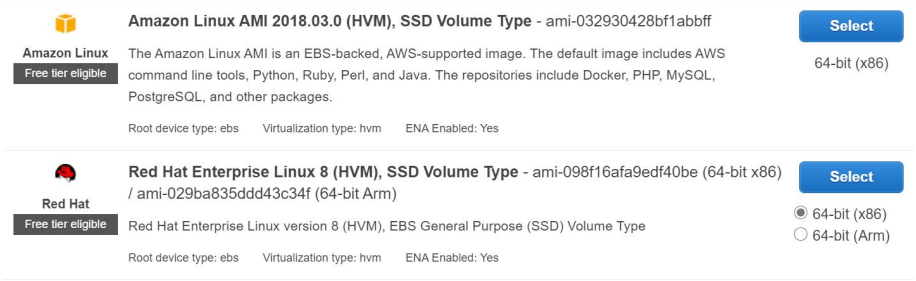
Since virtual machines are so essential, they are provided on all three of the main cloud service providers. Each platform provides a variety of options in OS, CPU size, storage size etc.

- AWS - Amazon EC2
- Azure - Azure Virtual Machines
- GCP - Compute Engine

5 A Deeper Look at AWS's EC2

AWS's EC2 is one of it's most popular products, offering users a wide array of customizable options for their virtual server instances.

- Processors - Choice of Intel Xeon, AMD EPYC, and AWS Graviton CPUs to find the best balance between performance and price. NVIDIA GPUs are also available for more computationally expensive tasks such as machine learning, gaming, and graphic intensive tasks
- AMIs - The Amazon Machine Image is a template software configuration that AWS provides for you (though you may also make your own if you wish). AMIs offer multiple different types of operating systems, application servers, and applications



- Instance Types - AWS provides a wide selection of instance types to support every type of application. They provide varying CPU, memory, storage, and network performance. The number of CPUs can range from 1 to 128, while memory can range from 0.5 to 3904 GiB.

	Family	Type	vCPUs	Memory (GiB)
☐	t2	t2.xlarge	4	16
☐	t2	t2.small	1	2
☐	t2	t2.nano	1	0.5

- Auto Scaling - This allows you to automatically scale your Amazon EC2 capacity up or down according to conditions you define. During demand spikes, you can add more EC2 instances to maintain performance, or scale down during demand lulls.