



# **VIRTUALIZATION 2.0**

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#### **About the Tutorial**

Virtualization 2.0 is a technology that helps users to install different Operating Systems on a hardware. They are completely separated and independent from each other. Virtualization hides the physical characteristics of computing resources from their users, their applications, or end users.

This is an introductory tutorial, which covers the basics of Virtualization 2.0 and explains how to deal with its various components and sub-components.

#### Audience

This tutorial is created for IT Managers and System Administrators, who want to learn how to install different OS on a hardware. It provides simple, easy to understand explanations with useful working examples. We will go through most of the important modules of Virtualization 2.0, so you can also use this as a reference for your future projects.

This tutorial is intended to make you comfortable in getting started with Virtualization 2.0 and its various functions.

#### **Prerequisites**

Since Virtualization 2.0 is all about operating systems and hardware, you will need to have a basic knowledge about the various OS and their elements.

Additionally, it will be helpful if you are familiar with various components such as a server, an application and various storage devices, if you want to understand all the information provided.

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# **1.** Virtualization – Overview

Virtualization is a technology that helps us to install different Operating Systems on a hardware. They are completely separated and independent from each other. In Wikipedia, you can find the definition as – "In computing, virtualization is a broad term that refers to the abstraction of computer resources.

Virtualization hides the physical characteristics of computing resources from their users, their applications or end users. This includes making a single physical resource (such as a server, an operating system, an application or a storage device) appear to function as multiple virtual resources. It can also include making multiple physical resources (such as storage devices or servers) appear as a single virtual resource..."

Virtualization is often:

- The creation of many virtual resources from one physical resource.
- The creation of one virtual resource from one or more physical resource

#### **Types of Virtualization**

Today the term virtualization is widely applied to a number of concepts, some of which are described below:

- Server Virtualization
- Client & Desktop Virtualization
- Services and Applications Virtualization
- Network Virtualization
- Storage Virtualization

Let us now discuss each of these in detail.

#### **Server Virtualization**

It is virtualizing your server infrastructure where you do not have to use any more physical servers for different purposes.





#### **Client & Desktop Virtualization**

This is similar to server virtualization, but this time is on the user's site where you virtualize their desktops. We change their desktops with thin clients and by utilizing the datacenter resources.



#### **Services and Applications Virtualization**

The virtualization technology isolates applications from the underlying operating system and from other applications, in order to increase compatibility and manageability. For example – Docker can be used for that purpose.





#### **Network Virtualization**

It is a part of virtualization infrastructure, which is used especially if you are going to visualize your servers. It helps you in creating multiple switching, Vlans, NAT-ing, etc.

The following illustration shows the VMware schema:





#### **Storage Virtualization**

This is widely used in datacenters where you have a big storage and it helps you to create, delete, allocated storage to different hardware. This allocation is done through network connection. The leader on storage is SAN. A schematic illustration is given below:



# **Understanding Different Types of Hypervisors**

A hypervisor is a thin software layer that intercepts operating system calls to the hardware. It is also called as the **Virtual Machine Monitor** (VMM). It creates a virtual platform on the host computer, on top of which multiple guest operating systems are executed and monitored.

Hypervisors are two types:

- Native of Bare Metal Hypervisor and
- Hosted Hypervisor

Let us now discuss both of these in detail.

#### Native or Bare Metal Hypervisor

Native hypervisors are software systems that run directly on the host's hardware to control the hardware and to monitor the **Guest Operating Systems**. The guest operating system runs on a separate level above the hypervisor. All of them have a Virtual Machine Manager.

Examples of this virtual machine architecture are **Oracle VM**, **Microsoft Hyper-V**, **VMWare ESX** and **Xen**.





#### **Hosted Hypervisor**

Hosted hypervisors are designed to run within a traditional operating system. In other words, a hosted hypervisor adds a distinct software layer on top of the host operating system. While, the guest operating system becomes a third software level above the hardware.

A well-known example of a hosted hypervisor is **Oracle VM VirtualBox**. Others include **VMWare Server and Workstation**, **Microsoft Virtual PC**, **KVM**, **QEMU** and **Parallels**.





# **Understanding Local Virtualization and Cloud**

Virtualization is one of the fundamental technologies that makes cloud-computing work. However, virtualization is not cloud computing. Cloud computing is a service that different providers offer to you based on some costs.

In enterprise networks, virtualization and cloud computing are often used together to build a public or private cloud infrastructure. In small businesses, each technology will be deployed separately to gain measurable benefits. In different ways, virtualization and cloud computing can help you keep your equipment spending to a minimum and get the best possible use from the equipment you already have.

As mentioned before, virtualization software allows one physical server to run several individual computing environments. In practice, it is like getting multiple servers for each physical server you buy. This technology is fundamental to cloud computing. Cloud providers have large data centers full of servers to power their cloud offerings, but they are not able to devote a single server to each customer. Thus, they virtually partition the data on the server, enabling each client to work with a separate "virtual" instance (which can be a private network, servers farm, etc.) of the same software.

Small businesses are most likely to adopt cloud computing by subscribing to a cloud-based service. The largest providers of cloud computing are **Microsoft with Azure** and **Amazon**.

The following illustration is provided by Microsoft where you can understand how utilizing extra infrastructure for your business without the need to spend extra money helps. You can have the on-premises base infrastructure, while on cloud you can have all your services, which are based on Virtualized technology.





In this chapter, we will discuss some of the most common advantages and disadvantages of Virtualization.

#### Advantages of Virtualization

Following are some of the most recognized advantages of Virtualization, which are explained in detail.

#### **Using Virtualization for Efficient Hardware Utilization**

Virtualization decreases costs by reducing the need for physical hardware systems. Virtual machines use efficient hardware, which lowers the quantities of hardware, associated maintenance costs and reduces the power along with cooling the demand. You can allocate memory, space and CPU in just a second, making you more self-independent from hardware vendors.

#### **Using Virtualization to Increase Availability**

Virtualization platforms offer a number of advanced features that are not found on physical servers, which increase uptime and availability. Although the vendor feature names may be different, they usually offer capabilities such as live migration, storage migration, fault tolerance, high availability and distributed resource scheduling. These technologies keep virtual machines chugging along or give them the ability to recover from unplanned outages.

The ability to move a virtual machine from one server to another is perhaps one of the greatest single benefits of virtualization with far reaching uses. As the technology continues to mature to the point where it can do long-distance migrations, such as being able to move a virtual machine from one data center to another no matter the network latency involved.

#### **Disaster Recovery**

Disaster recovery is very easy when your servers are virtualized. With up-to-date snapshots of your virtual machines, you can quickly get back up and running. An organization can more easily create an affordable replication site. If a disaster strikes in the data center or server room itself, you can always move those virtual machines elsewhere into a cloud provider. Having that level of flexibility means your disaster recovery plan will be easier to enact and will have a 99% success rate.

#### Save Energy

Moving physical servers to virtual machines and consolidating them onto far fewer physical servers' means lowering monthly power and cooling costs in the data center. It reduces carbon footprint and helps to clean up the air we breathe. Consumers want to see companies reducing their output of pollution and taking responsibility.



#### **Deploying Servers too fast**

You can quickly clone an image, master template or existing virtual machine to get a server up and running within minutes. You do not have to fill out purchase orders, wait for shipping and receiving and then rack, stack, and cable a physical machine only to spend additional hours waiting for the operating system and applications to complete their installations. With virtual backup tools like <u>Veeam</u>, redeploying images will be so fast that your end users will hardly notice there was an issue.

#### Save Space in your Server Room or Datacenter

Imagine a simple example: you have two racks with 30 physical servers and 4 switches. By virtualizing your servers, it will help you to reduce half the space used by the physical servers. The result can be two physical servers in a rack with one switch, where each physical server holds 15 virtualized servers.

#### Testing and setting up Lab Environment

While you are testing or installing something on your servers and it crashes, do not panic, as there is no data loss. Just revert to a previous snapshot and you can move forward as if the mistake did not even happen. You can also isolate these testing environments from end users while still keeping them online. When you have completely done your work, deploy it in live.

#### Shifting all your Local Infrastructure to Cloud in a day

If you decide to shift your entire virtualized infrastructure into a cloud provider, you can do it in a day. All the hypervisors offer you tools to export your virtual servers.

#### **Possibility to Divide Services**

If you have a single server, holding different applications this can increase the possibility of the services to crash with each other and increasing the fail rate of the server. If you virtualize this server, you can put applications in separated environments from each other as we have discussed previously.

#### **Disadvantages of Virtualization**

Although you cannot find many disadvantages for virtualization, we will discuss a few prominent ones as follows:

#### Extra Costs

Maybe you have to invest in the virtualization software and possibly additional hardware might be required to make the virtualization possible. This depends on your existing network. Many businesses have sufficient capacity to accommodate the virtualization without requiring much cash. If you have an infrastructure that is more than five years old, you have to consider an initial renewal budget.



#### Software Licensing

This is becoming less of a problem as more software vendors adapt to the increased adoption of virtualization. However, it is important to check with your vendors to understand how they view software use in a virtualized environment.

#### Learn the new Infrastructure

Implementing and managing a virtualized environment will require IT staff with expertise in virtualization. On the user side, a typical virtual environment will operate similarly to the non-virtual environment. There are some applications that do not adapt well to the virtualized environment.



There are several types of uses in virtualization, but the most commonly used are **Server Virtualization** and **Client Desktops Virtualization**. We have already discussed their advantages in the previous chapter and why are they used widely.

#### Virtualizing Desktop Computers

Client virtualization also called as VDI runs the entire desktop environment within a centralized server. All processing is done within the server. Client devices are typically thin clients that serve as an end node to connect I/O peripherals such as keyboard, mouse, a display, audio connectors and even USB ports over the LAN.



As discussed earlier, a thin client hardware is a computer terminal, which provides I/O for a keyboard, mouse, monitor, jacks for sound peripherals, and open ports for USB devices.

For example – Printer, Flash Drive, Web Cam, Card Reader, Smartphone, etc. Some thin clients include legacy serial and/or parallel ports to support older devices such as Receipt Printers, Scales, Time Clocks, etc. Thin client software typically consists of a GUI (graphical



user interface), Cloud Access Agents (for e.g. RDP, ICA, PCoIP), a local web browser, terminal emulations (in some cases) and a basic set of local utilities.

The largest producers of thin clients are HP, Dell and IBM.



#### **Running a Specific Program Solution**

One of the best software known for Desktop Virtualization is <u>XenApp & XenDesktop</u>. Deliver Windows, Linux, Web and SaaS applications or full virtual desktops to workers on any device and anywhere.

More information can be found on <a href="https://www.citrix.com/products/xenapp-xendesktop/">https://www.citrix.com/products/xenapp-xendesktop/</a>.

Another major provider is VMware with its platform called **VMware Horizon 7**. To purchase and understand all their features and specifications, click on the following link – <u>http://www.vmware.com/products/horizon.html</u>.

Microsoft is another provider with a combination of Remote desktop services along with **Hyper-V**. For any further Information on this, click on the following link – <u>https://technet.microsoft.com/en-us/windowsserver/ee236407.aspx</u>.



# Setting up Test and Development Environments

One of the most powerful features of a virtualized environment is the possibility to create labs for different approaches in a minute, especially in software development and then to import the same infrastructure in production.



Regarding the test environment, it brings cross-platform functionality to your dev-test environment and uses your preferred coding language to build natively. It tests your applications on the devices and platforms you use today: from Linux, Windows to iOS and Android.

All the features mentioned in the above can be done through private cloud or public cloud. It depends on what we would like to use as per the requirement. You should take into consideration the human resources with which you have to manage this cloud and the budget that you want to spend.



# 4. Virtualization – Hardware

In this chapter, we will discuss various components of hardware such as CPU, Memory, Storage and Networking.

#### Understanding Virtual CPU

When we install a hypervisor, each physical CPU is abstracted into virtual CPUs. This divides the available CPU cycles for each core and allows multiple VMs to "time share" a given physical processor core. Generally talking, the hypervisor typically assigns one workload per vCPU (per core). If the workloads on a server need more CPU cycles, it is better to deploy fewer VMs on a particular virtual CPU.

Let us consider the following example to understand the logic of virtual CPU.

I have a physical server with two processors (CPU 1 and CPU 2) and each of them has four physical cores. In total, we have 2\*4 = 8 physical cores.

Based on some calculations our hypervisor provided for each physical core, we can get 5-10 vCPUs.

In total, we will have [8 physical cores \* (5 to 10 vCPUs)] 40-80 vCPUs, which means that we can assign a maximum of 80 vCPUs to virtual machines.





# **Understanding Virtual Memory**

Virtual Memory in simple words is the RAM of the machine. The memory resource settings for a virtual machine determines how much of the host's memory is allocated to the virtual machine. The virtual hardware memory size determines how much memory is available to applications that run in the virtual machine.

A virtual machine cannot benefit from more memory resources than its configured virtual hardware memory size. The **ESXi hosts** limit the memory resource use to the maximum amount useful for the virtual machine, so that you can accept the default of unlimited memory resources.

You can add, change, and configure virtual machine memory resources or options to enhance virtual machine performance. You can set most of the memory parameters while creating the virtual machine or it can also be done after the **Guest Operating System** is



installed. Most of the hypervisors require to power off the virtual machine before changing the settings.

In the following schematic illustration, you can see that the total physical memory is divided between two virtual machines.



#### **Understanding Virtual Storage**

Storage virtualization is the pooling of physical storage (Data cluster) from multiple network storage devices into what appears to be a single storage device that is managed from a central console. We cannot assign more storage to virtual machines that data cluster offers physically.

You will see these extensions on the end of a file. Of all the files used as part of a virtual machine, different hypervisors like to use different file types. Some of the more common are **VDI**, **VHDX**, **VMDK** and **HDD**.

In the following example, we have a data cluster of 12 TB in total and four virtual machines to which we have allocated storage to each of them. In total, the maximum storage allocated to them is 12 TB.





# **Understanding Virtual Networking**

We will discuss this with a simple example as to how virtual networking done.

We have Virtual Machine 1, 2, 3 and 4 running on the same host. They would like to send the network traffic back and forth. This is done by virtual networking cards as shown in the following illustration (vNIC), which connects virtually with a virtual switch (vSwitch) that is created by the hypervisor.

This virtual switch communicates with a physical card of the server (pNIC), which is connected with a physical switch (pSwitch) and then communicates with the rest of the network equipment.

Please see the following schematically done up scenario.





In this chapter, we will discuss Microsoft Hyper-V along with its various modules.

# Installing Hyper-V in Windows Server 2012

Microsoft Hyper-V, known as Windows Server Virtualization, is a native (bare) hypervisor. It can create virtual machines on x86-64 systems running Windows OS, starting with Windows 8. Hyper-V supersedes **Windows Virtual PC** as the hardware virtualization component of the client editions of Windows NT. A server computer running Hyper-V can be configured to expose individual virtual machines to one or more networks.

Hyper-V was first released alongside Windows Server 2008 and Windows 7 and has been available without charge for all the Windows Server versions and some client operating systems since that time.

Let us see how to install a Hyper-V role in a Windows Server 2012 by following the steps given below.

**Step 1:** To Install Hyper-V role go to "Server Manager"  $\rightarrow$  Manage  $\rightarrow$  Add Roles and Features.





Step 2: Click on "Next".



**Step 3:** Select "Role-based or feature-based installation" option  $\rightarrow$  click on "Next".

a	Add Roles and Features Wizard	
Select installation	on type	DESTINATION SERVER
Before You Begin	Select the installation type. You can install roles and features on a running machine, or on an offline virtual hard disk (VHD).	g physical computer or virtual
Server Selection	<ul> <li>Role-based or feature-based installation Configure a single server by adding roles, role services, and features.</li> </ul>	]
	Remote Desktop Services installation Install required role services for Virtual Desktop Infrastructure (VDI) to or session-based desktop deployment.	create a virtual machine-based
		Luce French



**Step 4:** We will locally install the Hyper-V role as such "Select a server from the server pool"  $\rightarrow$  click "Next".

elect destinati	OII SEI VEI		
Before You Begin	Select a server or a	a virtual hard disk on which	to install roles and features.
Installation Type	Select a server	from the server pool	
Server Selection	O Select a virtual	hard disk	
Server Roles	Server Pool		
Features			
Confirmation	Filter:		
	Name	IP Address	Operating System
		192.168.0.40	Microsoft Windows Server 2012 Datacenter Evalua
	1 Computer(s) fou	nd	
	This page shows s Add Servers comm	ervers that are running Wir nand in Server Manager. Of	dows Server 2012, and that have been added by using fline servers and newly-added servers from which dat

**Step 5:** From the Roles lists, check the "Hyper-V" Server role  $\rightarrow$  click on Add Features on the popup window  $\rightarrow$  click "Next".

The destination server     Before You Begin     Installation Type	has a pending restart. We recommend that you restart the destin. Select one or more roles to install on the selected server. Roles	ation ser	ver before either installing o >
Server Selection Server Roles Features Confirmation Results		< I I I I I I I I I I I I I I I I I I I	Hyper-V provides the services that you can use to create and manage virtual machines and their resource. Each virtual machine is a virtualized computer system that operates in a isolated execution environment. The allows you to run multiple operation systems simultaneously.



#### Step 6: Click "Next".



**Step 7:** Choose your server's physical network adapters that will take part in the virtualization and responsible for network switching  $\rightarrow$  click on "Next"

<u>ک</u> ا	Add Role	s and Features Wizard				
Create Virtual S	witches		DESTINATION SERVER			
Before You Begin	Virtual machines require v role, you can create virtua	ritual switches to communicate with other comput il machines and attach them to a virtual switch.	ters. After you install this			
Installation Type Server Selection Server Roles	One virtual switch will be at least one virtual switch can add, remove, and more	One virtual switch will be created for each network adapter you select. We recommend that you create at least one virtual switch now to provide virtual machines with connectivity to a physical network. You can add, remove, and modify your virtual switches later by using the Virtual Switch Manager.				
Features	Network adapters:					
Hyper-V	Name	Description				
Virtual Switches	Ethernet	Intel(R) PRO/1000 MT Network Conn	ection			
Migration Default Stores Confirmation Results	We recommend that network adapter, do r	you reserve one network adapter for remote acces not select it for use with a virtual switch.	s to this server. To reserve a			



Fac.	Add Roles and Features Wizard	- • ×
Virtual Machine Before You Begin Installation Type Server Selection Server Roles Features Hyper-V Virtual Switches Migration Default Stores Confirmation Results	Migration         Hyper-V can be configured to send and receive live migrations of Configuring Hyper-V now enables any available network on this sey you want to dedicate specific networks for live migration, use Hype         Allow this server to send and receive live migrations of virtual relation protocol         Authentication protocol         Select the protocol you want to use to authenticate live migration         Is Use Credential Security Support Provider (CredSSP)         This protocol is less secure than Kerberos, but does not requidelegation. To perform a live migration, you must be logged         O Use Kerberos         This protocol is more secure but requires you to set up conservinonment to perform tasks such as live migration when migration server for live migration, including specifying networks, when the server for live migration, including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying networks, when the server for live migration including specifying ne	Virtual machines on this server. erver to be used for live migrations. If er-V settings after you install the role. machines ons. If you to set up constrained I on to the source server. trained delegation in your hanaging this server remotely. now. Instead, you will configure the you create the cluster.
	< Previous Next >	Install Cancel

**Step 8:** Under Migration, leave the default settings  $\rightarrow$  click on "Next".

**Step 9:** Choose the path where you want to save the file  $\rightarrow$  click on "Next".

έλ.	Add Roles and Features Wizard	- 0 X			
Default Stores		ESTINATION SERVER			
Before You Begin Installation Type Server Selection	Hyper-V uses default locations to store virtual hard disk files and virtual machine conf unless you specify different locations when you create the files. You can change these now, or you can change them later by modifying Hyper-V settings. Default location for virtual hard disk files:	figuration files, default locations			
Features	C/Users\Public\Documents\Hyper-V\Virtual Hard Disks	Browse			
Hyper-V	Default location for virtual machine configuration files:				
Virtual Switches	C:/ProgramData\Microsoft\Windows\Hyper-V	Browse			
Migration					
Default Stores					
Confirmation					
	< Previous Next > Install	Cancel			



fa:	Add Roles and Features Wizard	- 0 X
Confirm installa	ation selections	DESTINATION SERVER
Before You Begin Installation Type Server Selection Server Roles Features Hyper-V Virtual Switches Migration Default Stores Confirmation	To install the following roles, role services, or features on selected servi Restart the destination server automatically if required Optional features (such as administration tools) might be displayed on been selected automatically. If you do not want to install these options their check boxes. Hyper-V Remote Server Administration Tools Role Administration Tools Hyper-V Management Tools Hyper-V Module for Windows PowerShell Hyper-V GUI Management Tools	er, click Install. this page because they have il features, click Previous to clear
	Export configuration settings Specify an alternate source path	
	< Previous Next >	Install Cancel

**Step 10:** Click "Install" and wait for the installation bar to finish.

#### Installing Hyper-V in a windows 10 workstation

To install it in Windows 7, 8, 10 versions, you have to check if your computer supports virtualization. Following are the basic requirements:

- Windows 10 Pro or Enterprise 64-bit Operating System.
- A 64-bit processor with Second Level Address Translation (SLAT).
- 4GB system RAM at minimum.
- BIOS-level Hardware Virtualization support.

In my case, we have a laptop **HP Probook 450 G3**, which supports it.

Before continuing with the installation, follow the steps given below.

**Step 1:** Ensure that hardware virtualization support is turned on in the BIOS settings as shown below:



Device USB Se Slot S Dete Networ Virtu	System Secu	nity —	Freebland
	alization Technology	(VTx)	►Enabled
System Intel Intel Master	TXT(LT) Support	Accept,	Disabled

**Step 2:** Type in the search bar "**turn windows features on or off**" and click on that feature as shown below.





Step 3: Select and enable Hyper-V.

Wind	iows Features			$\times$
Turn V To turn a check be	Vindows features on or off a feature on, select its check box. To turn a fox. A filled box means that only part of the f	eature feature	off, clear is turned	its on.
	.NET Framework 4.6 Advanced Services Active Directory Lightweight Directory Se Embedded Shell Launcher Hyper-V	ervices		^
	Hyper-V Management Tools Hyper-V GUI Management Tools Hyper-V Module for Windows Por Hyper-V Platform Hyper-V Hypervisor Hyper-V Services	werShel	1	
T T	Internet Explorer 11 Internet Information Services	ж	Can	v cel

# Creating a Virtual Machine with Hyper-V

In this section, we will learn how to create a virtual machine. To begin with, we have to open the Hyper-V manager and then follow the steps given below.

**Step 1:** Go to "Server Manager"  $\rightarrow$  Click on "Hyper-V Manager".

		Server Manager	
Server M	anager • Hyper-V		
Dashboard Local Server All Servers AD DS	SERVERS All servers   1 total	<ul> <li>(ii) ▼</li> <li>(ii) ▼</li> <li>Last Update</li> </ul>	Windows A
DNS	Contine - Personal Contine - Per	Add Roles and Features Shut Down Local Server	Not activat
E Hyper-V To IIS		Computer Management Farmote Desktop Connection Windows PowerShell Configure NIC Tearning Configure Windows Automatic Feedback	
		Hyper-V Manager	
	All events   1 total	Manage At Start Performance Counters Refresh	
		Сору	
	Server Name ID Severity Source	Log	



Bill of the second seco	Hyper-V Manager	X
File Action View He	p	
Hyper-V Manager	Virtual Machines	Actions
	Name	New
	< Snapshots	Hyper-V Settings
		Edit Disk
	Details	<ul> <li>Stop Service</li> <li>Remove Server</li> <li>Refresh</li> </ul>
		View 🕨

Step 2: Click "New" on the left Panel or on the "Actions" button.

Step 3: Double-click on "Virtual Machine..."

and the second s			
File	Action View Help		
<b>(</b> = =	New >	Virtual Machine	
H	Import Virtual Machine	Hard Disk	-
	Hyper-V Settings	Floppy Disk	
	Virtual Switch Manager Virtual SAN Manager	▲ State	0
	Edit Disk Inspect Disk		
	Stop Service Remove Server Refresh	hots	



**Step 4:** A new table will open  $\rightarrow$  Type Name of your new machine  $\rightarrow$  click "Next".

<b>5.</b>	New Virtual Machine Wizard				
Specify Na	ame and Location				
Before You Begin	Choose a name and location for this virtual machine.				
Assign Memory	The name is displayed in Hyper-V Manager. We recommend that you use a name that helps you easily identify this virtual machine, such as the name of the guest operating system or workload.				
Configure Networking	Name: Windows 7				
Connect Virtual Hard Disk Installation Options	You can create a folder or use an existing folder to store the virtual machine. If you don't select a folder, the virtual machine is stored in the default folder configured for this server.	1			
Summary	Store the virtual machine in a different location				
	Location: C:\ProgranData\Microsoft\Windows\Hyper-V\ Erows	E			
	If you plan to take snapshots of this virtual machine, select a location that has enough free space. Snapshots include virtual machine data and may require a large amount of space.				

**Step 5:** A new table will be opened where you have to allocate the memory. Keep in mind you cannot choose more memory than you have physically.

8	New Virtual Machine Wizard
Assign Men	nory
Before You Begin Specify Name and Location	Specify the amount of memory to allocate to this virtual machine. You can specify an amount from 8 MB through 5816 MB. To improve performance, specify more than the minimum amount recommended for the operating system.
Assign Memory Configure Networking Connect Virtual Hard Disk Installation Options	Startup memory: 2048 MB Use Dynamic Memory for this virtual machine.  When you decide how much memory to assign to a virtual machine, consider how you intend to use the virtual machine and the operation system that it will run.
Summary	

Step 6: In the "Connection	" drop down box,	choose your physica	I network adaptor $\rightarrow$ c	lick on "Next".
----------------------------	------------------	---------------------	-----------------------------------	-----------------

<u>*</u>	New Virtual Machine Wizard				
Configure N	etworking				
Before You Begin Specify Name and Location	Each new virtual machine includes a network adapter. You can configure the network adapter virtual switch, or it can remain disconnected.	to use a			
Assign Memory	Connection: Intel(R) PRO/1000 MT Network Connection - Virtual Switch 🗸				
Configure Networking					
Connect Virtual Hard Disk					
Installation Options					
Summary					



**Step 7:** Now it is time to create a Virtual Hard disk, if you already have one, choose the second option.

<b>x</b>	New Virtual Machine Wizard	×
Connect Vi	rtual Hard Disk	
Before You Begin Specify Name and Location Assign Memory Configure Networking	A virtual machine requires storage so that you can install an operating system. You can specify the storage now or configure it later by modifying the virtual machine's properties. Create a virtual hard disk. Use this option to create a dynamically expanding virtual hard disk with the default format (VHC)	DKQ-
Gormect Writial Hand Dak Installation Options Summary	Name:       Windows 7, vhdx         Location:       C: (Users (Public (Documents (Hyper-V) (Virtual Hard Disks))         Size:       40         GB (Maximum: 64 TB)         Use an existing virtual hard disk         Use this option to attach an existing virtual hard disk, either VHD or VHDX format;	
	Location: C: Users Public Documents Hyper-V Writual Hard Disks      C     Attach a virtual hard disk later     Use this option to skip this step now and attach an existing virtual hard disk later.	
	< Previous Next > Finish Cance	4

**Step 8:** Select the Image of ISO that has to be installed  $\rightarrow$  click on "Finish".

Before You Begin Specify Name and Location Assign Memory	You can install an operating syste later.	m now if you have access to the setup media, or you ter	can install it
Configure Networking Connect Virtual Hard Disk Installation Options Summary	Instal an operating system fr Media     Physical CD/DVD drive:     Image file (.iso):	om a boot CD/DVD-ROM           Dr         w           C: Wsers Administrator Wesktop Windows7 x86.tl	Browse
	Instal an operating system from     Media     Vertual Roopy dak (setd):	am a boot floppy disk	Browne
	Install an operating system fr	om a network-based installation server	



**Step 9:** After clicking on finish, you would get the following message as shown in the screenshot below.

Completing	New the New Virtual M	Virtual Machine Wizard achine Wizard	
Before You Begin Specify Name and Location Assign Memory Configure Networking Connect Virtual Hard Disk Installation Options Summary	You have successfully following virtual mach Description: Name: Memory: Network: Hard Disk: Operating System:	v completed the New Virtual Machine Wizard, Yo ine. Windows 7 2048 MB Intel(R) PRO/1000 MT Network Connection - Y C: [Lisers'Public:[Documents']Hyper-V[Virtual Ha Will be installed from C::[Lisers']Administrator'[D	ou are about to create the Wrtual Switch and Disks\Windows 7.vhdx (VHDX, o Desktop\Windows7 x86.iso
	<	н	>

**Step 10:** To connect to the Virtual machine, Right Click on the created machine  $\rightarrow$  click on "Connect..."

Virtual Machines						
Name 📩	State		CPU Usage	Assigned	Memory	Uptime
Windows 7	Off				-	
		Co	nnect			
		Set	ttings			
<		Sta	art			
Snapshots		Sn	apshot			
		M	ove		as no snaps	shots.
		Exp	port			





**Step 11:** After that, installation of your ISO will continue.

# Setting up Networking with Hyper-V

The Hyper-V vSwitch is a software, layer-2 Ethernet network-traffic switch. It allows administrators to connect VMs to either physical or virtual networks. It is available by default within the Hyper-V Manager installation and contains extended capabilities for security and resource tracking.

If you attempt to create a VM right after the set-up process, you will not be able to connect it to a network.

To set up a network environment, you will need to select the **Virtual Switch Manager** in the right hand side panel of Hyper-V Manager as shown in the screenshot below.



	Нура	er-V Manager			-	
Virtual Machines					Actions	
Name Prov	State Running Running Off	CPU Usage 0% 0%	Assigned Memory 2512 MB 8000 MB	Upi 21: 3.1	New New Hyper-V Settings Virtual Switch Manager Virtual SAN Manager	•
Checkpoints	ш				Edit Disk  Edit Disk  Stop Service	
Now	<b>.</b> 4	E AM)			Kernove Server     Refresh     View     Help	•
				_	Active directory	•
Active directory Created: Version: Generation Notes:	8/15/2016 1 5.0 oec 1 None	9:28:51 AM	Clustered: No Heartbeat: OK ( Data Integration Services:	No App ) ite requ	Settings     Turn Off     Shut Down     Save     Pause     Reset	
	Virtual Machines Name	Virtual Machines Name State Running	Hyper-V Manager       Virtual Machines       Name     State     CPU Usage       Name     9 %     8uning     0%       Running     0%     0%     0%       Checkpoints     48 AMI       Active directory       Created:     8/15/2016 9:28:51 AM       Version:     5.0       Generation:     1       Note:     None	Hyper-V Manager	Hyper-V Manager       Virtual Machines       Name     State     CPU Usage     Assigned Memory     Up       Name     0%     2512 ME     212       Purning     0%     3000 MB     3.1       Checkpoints     Checkpoints       Now     48 AM       Active directory       Version:     5.0       Generation:     1       Note:     None	Virtual Machines       Actions         Name       State       CPU Usage       Assigned Memory       Upt         Name       Bixmag       0%       2512 MB       211         Runng       0%       8000 MB       3.11         Hyper-V Settings       Hyper-V Settings       Hyper-V Settings         Checkpoints       Import Virtual SAN Manager       Edit Disk         Now       48 AM       Inspect Disk       Inspect Disk         Now       Kernet       Kinov       Remove Server         Refersh       View       Help         Active directory       Cannet       Settings         Created:       8/15/2015 9:28:51 AM       Clustered:       No         Created:       8/15/2015 9:28:51 AM       Clustered:       No         Generation:       1       Integration:       Update rop         Based       Integration:       Update rop         Notes:       None       Services:       Reset

The Virtual Switch Manager helps configure the vSwitch and the Global Network Settings, which simply lets you change the default 'MAC Address Range', if you see any reason for that.

Creation of the virtual switch is easy and there are three vSwitch types available, which are described below:

- **External vSwitch** will link a physical NIC of the Hyper-V host with a virtual one and then give your VMs access outside of the host. This means that your physical network and internet (if your physical network is connected to internet).
- **Internal vSwitch** should be used for building an independent virtual network, when you need to connect VMs to each other and to a hypervisor as well.
- **Private vSwitch** will create a virtual network where all connected VMs will see each other, but not the Hyper-V host. This will completely isolate the VMs in that sandbox.



Virtual Switches     New virtual network switch	Create virtual switch     What type of virtual switch do you want to create?
Intel(R) 1210 Gigabit Network Con Global Network Settings MAC Address Range MAC Address Range	External Internal Private
	Create Virtual Switch Creates a virtual switch that binds to the physical network adapter so that virtual machines can access a physical network.

Here, we have selected "External" and then "Create Virtual Switch". The table with the setting of the vSwitch will be open where we will fill the fields as shown below:

- **Name:** is the name that we will put to identify the vSwitch.
- **Notes:** is the description for us, generally, we put friendly descriptions to be understood.
- **Connection Type:** is external as explained earlier and selects a physical network card on my server.

Once all this is entered, Click on "OK".


•	New virtual network switch	Name:		
	Intel(R) I210 Gigabit Network Con	External switch		
External switch Intel(R) Ethernet Connection		Notes:		
	Global Network Settings	connection to internet for my VM machines		
13	MAC Address Range 00-15-5D-08-13-00 to 00-15-5D-0	· · · · · · · · · · · · · · · · · · ·		
		Connection type		
		What do you want to connect this virtual switch to?		
		External network:		
		Intel(R) Ethernet Connection I217-LM		
		✓ Allow management operating system to share this network adapter		
		Enable single-root I/O virtualization (SR-IOV)		
		O Private network		
		VLAN ID		
		Enable virtual LAN identification for management operating system		
		The VLAN identifier specifies the virtual LAN that the management operating system will use for all network communications through this network adapter. This setting does not affect virtual machine networking.		
		2		
		Remove		
		SR-IOV can only be configured when the virtual switch is created. An external virtual switch with SR-IOV enabled cannot be converted to an internal or private switch.		
		Activate Wi		

## Allocating Processors & Memory to a VM using Hyper-V

In this section, we will see the task of allocating CPU, Memory and Disk Resources to the virtual machines that are running on a server. The key to allocating CPU or any other type of resource in Hyper-V is to remember that everything is relative.

For example, Microsoft has released some guidelines for Virtualizing Exchange Server. One of the things that was listed was that the overall system requirements for Exchange Server are identical whether Exchange is being run on a virtual machine or on a dedicated server.





To allocate one of the features mentioned above, we need to click on the "Settings..." tab in the right hand side panel.

To allocate more memory to the selected virtual machine, click on the "Memory" tab on the left hand side of the screen. You will also have "Startup RAM", where you can allocate as much ram as you have physically to a VM machine  $\rightarrow$  Click on "Ok".

A Hardware		0	Memory
Add Hardwa	re		
ELOS			You can configure options for assigning and managing memory for this virtual machine
Boot from C	Ú.		Specify the amount of memory that this virtual machine will be started with.
BUCC MD			Startup RAM: 8000 MB
E Processor	April 1		Dynamic Memory
E IDE Control	er 0		You can manage the amount of memory assigned to this virtual machine dynamically within the specified range.
E Ca Hard Dr	e nadin		Enable Dynamic Memory
E IDE Control	er 1 re		Minimum RAM: B000 ME
SW_DH	05_Windows_Svr		Maximum RANK: B000 HS
<ul> <li>Network Ad External</li> </ul>	apter		Specify the percentage of memory that Hyper-V should by to reserve as a buffer- Hyper-V uses the percentage and the current demand for memory to determine an initia or of common for this lucifier.
COM 1 None			Manuary Justier 20167 No.
TOCM 2			
Diskette Driv	/e		Specify how to prioritize the availability of memory for this virtual machine
A Management			conqueres to ourse in total masteries on and composite.
I Name Inventory s	afbiare machine		Low High
Integration Some service	Services as offered		Specifying a lower setting for this virtual machine might prevent it from starting when other virtual machines are running and available memory is low.
Chedpoint : E: Univentar	Pie Location y software Universita		
Smart Pagin El Univentor	g File Location y software Universito		
Automatic S Restart dip	tert Action reviously running	-	



To allocate more processors, click on the "Processor" tab on the left hand side of the panel. Then you can enter the number of virtual processors for your machine.

A Hardware	~	Processor
Add Hardware BIOS Boot from CD Memory 8000 MB		You can modify the number of virtual processors based on the number of processors on the physical computer. You can also modify other resource control settings. Number of virtual processors: $1 \sqrt[3]{2}$
🖲 📕 Processor		Resource control
1 Virtual processor		You can use resource controls to balance resources among virtual machines.
B IDE Controller 0	-	Virtual machine reserve (percentage): 0
Hard Drive	- machin	Percent of total system resources: 0
E IDE Controller 1		
DVD Drive		Virtual machine limit (percentage): 100
Contraction of the local division of the loc	Svir	Percent of total system resources: 25
SCSI Controller		
E Wetwork Adapter External		Relative weight: 100
TOM 1		
None		
COM 2		
Diskette Drive		
None		
A Management		
1 Name	1000	
Inventory somware i	nacime	
Some services offere	ed	
🔊 Checkpoint File Locat	ion	
El	e\linversto	
Smart Paging File Loc	abon nvento	
Automatic Start Actio	n	
Restart if previously	running 🗸	
a Ta		Activate Wind



If you need to expand, compress the capacity of the virtual hard disk. Click on the "IDE controller 0" on the left hand side panel  $\rightarrow$  click on "Edit".





<u>,63</u>	Edit Virtual Hard Disk Wizard	×
Locate V	/irtual Hard Disk	
Before You Begin Locate Disk Choose Action Summary	Where is the virtual hard disk file located?         Location:       Example following types of virtual hard disks might result in data loss:         •       Wrtual hard disks in a differencing disk chain that have child virtual hard disks associated with them.         •       Wrtual hard disks (avhd/avhdx) associated with virtual machine checkpoints.         •       Wrtual hard disks associated with a virtual machine that has replication enabled and is currently involved in initial replication, resynchronization, test failover, or failover.	
	< Previous Next > Fresh Cancel	1

Once all the above changes are done, Click on  $``{\sf Next}''$ 

Select one of the options based on your need (all of them have their respective descriptions) and then click on "Next".

ø	Edit Virtual Hard Disk Wizard	×
Choose A Before You Begin Locate Disk Choose Action Summary	Action What do you want to do to the virtual hard disk?  Compact This option compacts the file size of a virtual hard disk. The storage capacity of the remains the same. Convert This option converts a virtual hard disk by copying the contents to a new virtual hard disk can use a different type and format than the original virtual hard di Expand This option expands the capacity of the virtual hard disk.	virtual hard disk rd disk. The new Isk.
	< Previous Next > Finish	Cancel



Click on "Finish" and wait for the process to finish.

<u>e</u>	Edit Virtual Hard Disk Wizard
Complet	ing the Edit Virtual Hard Disk Wizard
Before You Begin Locate Disk Choose Action	You have successfully completed the Edit Virtual Hard Disk Wizard. You are about to make the following changes. Description:
Summary	Virtual Hard Disk: Compact Virtual Action: Compact
	To complete the action and close the wizard, click Finish.
	< Previous Next > Finsh Cancel

### Using Checkpoints in Hyper-V

Checkpoints in Hyper-V are called snapshots and they help us to revert the machine in a desired state that we had in the past.

To create a checkpoint we should follow the steps given below.

Step 1: Select the VM by clicking on it. On the left hand side panel, click on "Checkpoint".

Purring 01, 2512 MB 1 Purring 01, 8000 MB 0 ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )	
Inventory software machine	View  Help  View  Consect. Setings. Start
Created:         1/1/1921 1:00:00 AH         Oustered:         No           Version:         5.0         Generation:         1           Notes:         None         Summary         Networking         Replication:	Checkpoint Move Export Rename Delate Explore Replication Active



с п	Virtual SAN Manager
Checkpoints	A inspect Disk
E Anno 100 - 112/14/2016 - 10:54:36 AM	Stop Service     Kenove Server     Refresh
	View
	Help
	e machine
Participation and the second sec	Connect
Inventory software machine	Settings
Created: 1/1/16011.00.00.4M Clustered: No Version: 5.0 Secention: 1	Start     Start     Checkpoint     Revet
Notes: None	Move Export

**Step 2:** The following checkpoint will be created with the respective date and time in the main Hyper-V manager console.



In this chapter, we will understand how to install the VMware Workstation Player and its usages.

#### Installing VMware Workstation Player

VMware workstation player is a "hosted hypervisor", so you have to have a pre-installed OS before continuing to install it.

VMware workstation player is free version and available for non-commercial, personal and home use. They also encourage students and non-profit organizations to benefit from this offering. To download the VMware workstation player, you can click on the following link – <u>http://www.vmware.com/products/player/playerpro-evaluation.html</u>. To install the VMware workstation player, follow the steps given below.



Step 1: Click on "Download Now" as shown in the screenshot below.





**Step 2:** You will see that a file has been downloaded  $\rightarrow$  double click on it.

	WWware Workstation	n 12 Player Setup	an Player.
		Welcome to the VMware Workstation 12 Player Setup Wizard	re advanced virtualization Workstation Pro for Wind IX
	WORKSTATIO	The Setup Wizard will install VMware Workstation 12 Player on your computer. Click Next to continue or Cancel to exit the Setup Wizard.	
are Workstat	tion 1:		tation 12.5 Player f
t vnload Now »		Copyright 1998-2016 VMware, Inc. All rights reserved. This product is protected by U.S. and international copyright and intellectual property laws. VMware products are covered by one or more patents listed at:	
1.	<b>vm</b> ware	http://www.vmware.com/go/patents	

Step 3: A Table will pop-up initializing the installation of VMware -> Click "Next"



đ	Commerce VMware Workstation 12 Player Setup	al organizations require pai Player
	End-User License Agreement Please read the following license agreement carefully.	re advanced virtualization Workstation Pro for Window
	VMWARE END USER LICENSE AGREEMENT	
ation 1.	PLEASE NOTE THAT THE TERMS OF THIS END USER LICENSE AGREEMENT SHALL GOVERN YOUR USE OF THE SOFTWARE, REGARDLESS OF ANY TERMS THAT MAY APPEAR DURING THE INSTALLATION OF THE SOFTWARE.	tation 12.5 Player fo
	I accept the terms in the License Agreement      Print Back Next Cancel	
ET SUPPO	RT ABOUT VMWARE CAREERS	

**Step 4:** Check the box "I accept the terms in the license agreement"  $\rightarrow$  Click on "Next".

Step 5: Once again, click on the "Next" button.





User	are Workstation 12 Player Setup 🗐 🛛 🗐 🗙 Experience Settings	re a
Ed	t default settings that can improve your user experience.	Worl IX
4	Check for product updates on startup When VMware Workstation 12 Player starts, check for new versions of the application and installed software components.	-
1	Help improve VMware Workstation 12 Player Send anonymous system data and usage statistics to VMware.	:tati
	Learn More	
	Back Next Cancel	
PPORT	ABOUT VMWARE CAREERS	

Step 6: Leave the default values and click on "Next".

Step 7: Once again, click on "Next".





Step 8: Click on "Install".



**Step 9:** An icon will be created on the desktop. Click on it and a table will pop-up, where you have two possibilities: If you want to use it as a non-commercial version, just enter your email address. If you want to use it as a commercial version, check the second option and enter your serial key.

Ran Votes	Welcome to Whene Workstation 12 Player  VMware Workstation 12 Player  C Use Where Workstation 12 Player for free for ann-commercial use
	Enter a valid ental address, tou agree to reconve connectional entals from Otheren validate for Eleven forellaps@hotmail.com
New föder	Carcol



### Creating a VM with VMware Workstation

To create a virtual machine, we have to follow the steps given below.

**Step 1:** Click on "Player"  $\rightarrow$  File  $\rightarrow$  New Virtual Machine.



**Step 2**: A table will pop-up requesting you to find a "Boot disk", "Boot Image" or to install OS at a later stage.

We will choose the second option and click on "Browse". Then we have to click on the ISO image, which we want to install. Once all this is done, click on "Next".

	New Yirtual Machine Wizard
	Welcome to the New Virtual Machine Wizard A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?
	Install from:
	C Installer disc:
2.0.0	C DVD RW Drive (E:)
ed Off	Installer disc image file (iso):
red Off u station E	Installer disc image file (iso):     C:\Users\Administrator\Desktop\New folder\win2k12.b      Browse
red Off u station E	<ul> <li>Installer disc image file (iso):</li> <li>C:\Users\Administrator\Desktop\New folder\win2k12.i.</li> <li>Windows Server 2012 R2 detected, This operating system will use Easy Install. (What's this?)</li> </ul>
red Off u station E 3	<ul> <li>Installer disc image file (iso):</li> <li>C:\Users\Administrator\Desktop\New folder\win2k12.b Browse</li> <li>Windows Server 2012 R2 detected. This operating system will use Easy Install. (What's this?)</li> <li>I will install the operating system later.</li> </ul>
red Off tu station E 3	<ul> <li>Installer disc image file (iso):         <ul> <li>C:\Users\Administrator\Desktop\New folder\win2k12.t Browse</li> <li>Windows Server 2012 R2 detected. This operating system will use Easy Install. (What's this?)</li> <li>I will install the operating system later. The virtual machine will be created with a blank hard disk.</li> </ul> </li> </ul>



**Step 3:** As I am installing windows server 2012, it will pop-up a table requesting to enter the serial key  $\rightarrow$  click directly on "Next", if you want to activate the non-commercial version for Windows.

Windows produ	uct key				
	· · ·	•	•		
Version of Win	dows to install				
	Windows Serve	r 2012 R2	Datacenter	٠	1
Personalize Wi	ndows				
Full name:	administrator				
Password:					(optional)
Continue	-				6
Password:	administrator				(optio

Step 4: After the above step is complete, a dialogue box opens. Click "Yes".

	You did not e	pter a Windows product	key Windows
na ?	will install with	nout one, but must be m	anually
	activated late	er. Would you like to cor	itinue?
In			
		Yes	No



#### Step 5: Click "Next".

1	New Virtual Machine Wizard	×
4	Name the Virtual Machine What name would you like to use for this virtual machine?	
	Virtual machine name:	
	Windows Server 2012	
n.	Location:	
	C:\Users\Administrator\Documents\Virtual Machines\Windows Se Browse	
f		
ε		
sie		
111		
in	< Back Next > Cano	el Í

**Step 6:** In the "Maximum size disk" box, enter the value of your virtual Hard disk, which in our case is 60GB. Then click on "Next".

N	New Virtual Machine Wizard	
	Specify Disk Capacity How large do you want this disk to be?	
	The virtual machine's hard disk is stored as one or more files on the computer's physical disk. These file(s) start small and become large add applications, files, and data to your virtual machine.	host r as you
	Maximum disk size (GB): 60.0	
0	Recommended size for Windows Server 2012: 60 GB	
ff	Store virtual disk as a single file	
e	Split virtual disk into multiple files	
i c	Splitting the disk makes it easier to move the virtual machine to computer but may reduce performance with very large disks.	another
hir		
nin-		
	Help < Back Next >	Cancel





Ready to Create	Virtual Machine
Click Finish to o Server 2012 ar	create the virtual machine and start installing Windows and then VMware Tools.
he virtual machine v	vil be created with the following settings:
Name:	Windows Server 2012
Location:	C:\Users\Administrator\Documents\Virtual Machines\.
Version:	Workstation 12.0
Operating System:	Windows Server 2012
Hard Disk:	60 GB
Memory:	1024 MB
Network Adapter:	NAT
Other Devices:	CD/DVD, USB Controller, Printer, Sound Card
Network Adapter: Other Devices: Customize Hardw Power on this virt	NAT CD/DVD, USB Controller, Printer, Sound Card are

# Setting up Networking with VMware Workstation

To set up the networking modes of a virtual machine in a VMware Workstation, we have to click on the "Edit virtual machine settings".





A table will be opened with the settings of networking and on the left hand side panel of this table click on "Network Adaptor".

Device	Summary	Device status
Memory	1 G8	Connected
Processors	1	Connect at power on
Hard Disk (SCSI)	60 GB	- Carrow and the second second
CD/DVD (SATA)	Using file c:\Users\Administrator\	Network connection
Network Adapter	NAT	Bridged: Connected directly to the physical network
USD Controllor	Present	Replicate physical network connection state
🕖 Sound Card	Auto detect	Configure Adapters
Printer	Present	NAT: Used to share the host's IP address
Display	Auto detect	C Host-only: A private network shared with the host
		C 1 MI comments
		· LAW Segments
		<u> </u>
		LAN Segments Advanced
	Remove	



On the left of this table, you can see the networking modes as shown in the following screnshots.

Device status	
Connect at p	ower on
Network connect	ion
C Bridged: Con	nected directly to the physical network
🔲 Replicate	physical network connection state
	Configure Adapters
NOT: Used by	share the bost's IP address
C Host-ophy A	private petwork chared with the boot
Host-only: A	private network shared with the host
C LAN segment	<b>t</b>
	<b>*</b>
	<b>Y</b>
	LAN Segments
	LAN Segments
	LAN Segments
	ZAN Segments Advanced
	LAN Segments
	LAN Segments
	LAN Segments
	LAN Segments Advanced
	LAN Segments
	LAN Segments Advanced
	LAN Segments Advanced



Device status	
Connected	
Connect at power on	Network Adapter Advanced Settings
Network connection	Incoming Transfer
C Bridged: Connected directly to the physical network	Bandwidth:
Replicate physical network connection state	
Configure Adapters	Kops:
NAT: Lised to share the host's IP address	Packet Loss (%): 0.0
C Host-only: A private network shared with the host	
C. Marine	Outgoing Transfer
CAV segment:	Bandwidth: Unlimited
	Kbps:
LAN Segments	Packet Loss (%): 0.0 *
	MAC Address
	Generate
	OK Cancel Help

If we want to limit the bandwidth usage of a virtual machine, click on "Advance" and set the incoming and outgoing bandwidths.

# Allocating Processors & Memory to a VM using VMware Workstation

To allocate memory to a virtual machine in a VMware Workstation, we have to click on "Edit virtual machine settings". A table will be opened and we will have to click on "Memory".



On the left hand side panel, we have to enter the amount of memory manually or by moving the arrow up and down as shown in the following screenshot.

Device	Summary	Memory
Memory Processors Hard Disk (SCSI) CD/DVD (SATA) Floppy Network Adapter USB Controller Sound Card Printer Display	1 GB 1 60 GB Using file C:\Users\Administrator\ Using file autoinst.flp NAT Present Auto detect Present Auto detect	Specify the amount of memory allocated to this virtual machine. The memory size must be a multiple of 4 MB. Memory for this virtual machine:
	😚 Add 📔 Remove	



If you click on "Processors". On the left hand side panel, we have to enter the amount of vCPU as shown in the screenshot below.

Device	Summary	Processors
Memory Processors	1 G8	Number of processor cores:
Hard Disk (SCSI) CD/DVD (SATA) Floppy Network Adapter USB Controller Sound Card Printer Display	60 GB Using file C:\Users\Administrator\ Using file autoinst.flp NAT Present Auto detect Present Auto detect	Virtualization engine Preferred mode: Automatic Disable acceleration for binary translation Virtualize Intel VT-x/EPT or AMD-V/RVI Virtualize CPU performance counters
	Semove	



 Processors

 Number of processor cores:

 Powering on the virtual machine will fail because it is configured to use more virtual processor cores than the host supports.

 Virtualization engine

 Preferred mode:
 Automatic

 Image: Disable acceleration for binary translation

 Virtualize Intel VT-x/EPT or AMD-V/RVI

 Virtualize CPU performance counters

**Note:** If you put more vCPU-s than what the host supports, it will fail to power on the VM.

### **Duplicating a VM Using VMware Workstation**

To create duplicates of VM machines, we have to use the VMware Workstation Commercial Version.

Let us see how to do it in practice by following the steps given below.



🔓 Hone 🗶 💭 Windows 7 🗶 🕞 Ubuntu 🗶 Type here to search . Windows 7 😑 📲 My Computer Ubu Close Tab his virtual machine machine settings a dsl-i Mark as Favorite is virtual machine G Shared Rename\_ Remove 1 Power 1 GB . Removable Devices 1 \$C\$0 80 GB Pause (B) Auto detect Send Ctrl+Alt+Del Auto detect Grab Input Bapter NAT Snapshot iller Present Aute detect Capture Screen Capture Movie ... Present Auto detect Anage / . Settings ... ter a description of this

**Step 1:** Open the VMware managing console and right click on a VM that you want to duplicate. Click on "Manage".

**Step 2:** Click on "Clone..." and a wizard will be open.

🔓 dsl-4 聲 Shared V		Mark as Favorite Rename Remove	mac is vir	hine settings tual machine
	ம	Power >	L .	1 GB
	5	Removable Devices		1
		Pause	SCSI	80 GB
	æ	Send Ctrl+Alt+Del Grab Input	)E) dapte	Auto detect Auto detect er NAT
	0	Snapshot + Capture Screen Capture Movie	oller	Present Auto detect Present
	2	Manage	8	Change Hardware Compatibility
		Install VMware Tools	<b>*</b> *	Clone
	ីរី	Settings		Upload Download
			4	Clean Up Disks



#### Step 3: Click on "Next".



Step 4: Click on "Create a Full Clone" and "Next".

Clone Type	
How do yo	u want to done this virtual machine?
Clone method	
Oreate a link	ed done
A linked dor disk space t virtual mach	e is a reference to the original virtual machine and requires less o store. However, it cannot run without access to the original line.
Create a full A full done i state. This	cone s a complete copy of the original virtual machine at its current virtual machine is fully independent, but requires more disk space
to store.	
to store.	
to store.	



one Virtual Ma	chine Wizard	
Name of the What nam	New Virtual Machine we would you like to use for this virtual machine?	
Virtual machine	name	
Clone of Wind	ows 7	
Location	G	
C:\Users\	Documents Virtual Machines Clone of Window	Browse
	Called Park	Canad
	< Back Finish	Cancel

**Step 5:** Put a name for the clone that will be created and "Finish".

The following screenshots describe the process of cloning.

Ione Virtual Machine Wizard	13
Cloning Virtual Machine	
✓ Preparing done operation	
VMware Workstation	
Cloning	
t.	
	Cancel





Once the cloning process is complete, the following window will open.



# 7. Virtualization – VirtualBox

In this chapter, we will understand what a VirtualBox is and discuss in detail the various components it has.

#### Installing VirtualBox

To start with, we will download VirtualBox and install it. We should follow the steps given below for the installation.

**Step 1:** To download VirtualBox, click on the following link – <u>https://www.virtualbox.org/wiki/Downloads</u>. Now, depending on your OS, select which version to install. In our case, it will be the first one (Windows host).



Step 2: Once the option is selected, click on "Next".





**Step 3:** You have the option asking where to install the application. We can leave it as default and click on "Next".

Image: WirtualBox Application       Oracle VM VirtualBox 5.1.2 application.         Image: WirtualBox USB Support       Oracle VM VirtualBox 5.1.2 application.         Image: WirtualBox Networking       Image: WirtualBox Bridged Networking         Image: WirtualBox Host-Only Networking       This feature requires 164MB on your hard drive. It has 3 of 3 subfeatures selected. The subfeatures require 692KB on yo	Click on the ico	ons in the tree below to	change the	way features will be installed.
III     Subreatures require 092kb oil yo		Application tualBox USB Support tualBox Networking VirtualBox Bridged VirtualBox Host-O tualBox Python 2.x Su	d Networkin Inly Networ Ipport	Orade VM VirtualBox 5.1.2 application. This feature requires 164MB on your hard drive. It has 3 of 3 subfeatures selected. The
	( E		•	subleatures require 6924b on yo

**Step 4:** Once the options are selected as shown in the following screenshot, click on Next.

Custom Setup		
Select the way you want feature	is to be installed.	
Please choose from the options b	selow:	
Create a shortcut on the desk	ktop	
Create a shortcut in the Quid	k Launch Bar	
Register file associations		



**Step 5:** A dialog box will come up asking whether to proceed with the installation. Click "Yes".



Step 6: In the next step, click on "Install".







Step 7: Tick the start VirtualBox check box and click on "Finish".

**Step 8:** VirtualBox application will now open as shown in the following screenshot. Now, we are ready to install the virtual machines.





# Creating a VM with VirtualBox

To create a virtual machine with Oracle VirtualBox, we should follow the steps given below.

**Step 1:** To begin with, click on the "Oracle VM VirtualBox" icon on the desktop as shown in the screenshot below.





**Step 2:** The next step is to click on "New" button, which is in the top left hand side of the screen.



**Step 3:** A table will pop-up requesting you the parameters for the virtual machine. These will be –

- **Name:** We have to put a friendly name for this Virtual Machine.
- **Type:** Enter the OS that is going to be installed on it.
- Version: Enter the specific version for that OS, which we have selected earlier.



Once all the above parameters are filled, click on "Next".

π

	? ×					
← Create	e Virtual Machine					
Name	and operating system					
Please o operatir through	Please choose a descriptive name for the new virtual machine and select the type of operating system you intend to install on it. The name you choose will be used throughout VirtualBox to identify this machine.					
1 Name:	tutorialspoint.com					
2 Type:	Microsoft Windows					
Version:	Windows 7 (64-bit)					
	Expert Mode Next Cancel					

**Step 4:** Select the amount of memory that you need to allocate in this VM  $\rightarrow$  Click on "Next".

	?	×
← Create Virtual Machine		
Memory size		
Select the amount of memory (RAM) in megabytes to be allocated to the machine.	virtual	
The recommended memory size is <b>512</b> MB. 4 MB 8192 MB	512	🗣 мв
Next	Car	ncel



Step 5: Check one of the three options for the HDD and click on "Create".

? ×
← Create Virtual Machine
Hard disk
If you wish you can add a virtual hard disk to the new machine. You can either create a new hard disk file or select one from the list or from another location using the folder icon.
If you need a more complex storage set-up you can skip this step and make the changes to the machine settings once the machine is created.
The recommended size of the hard disk is 25.00 GB.
O Do not add a virtual hard disk
Create a virtual hard disk now
O Use an existing virtual hard disk file
🗟 AC2.vdi (Normal, 25.00 GB) 🗾 🗔
Create Cancel

**Step 6:** Select a file extension for your virtual HDD (It is recommended to use a common file extension that most of the hypervisors use like VHD)  $\rightarrow$  click on "Next".

	?	×
<ul> <li>Create Virtual Hard Disk</li> </ul>		
Hard disk file type		
Please choose the type of file that you would like to use the hard disk. If you do not need to use it with other virtualiz can leave this setting unchanged.	for the new virt ation software	you
VDI (VirtualBox Disk Image)		
O VMDK (Virtual Machine Disk)		
O VHD (Virtual Hard Disk)		
O HDD (Parallels Hard Disk)		
O QED (QEMU enhanced disk)		
O QCOW (QEMU Copy-On-Write)		
Expert Mode Nex	ct Ca	ncel



**Step 7:** Choose whether you want the Virtual HDD as dynamic or fixed. This is based on your needs  $\rightarrow$  Click on "Next".

	? ×		
•	← Create Virtual Hard Disk		
	Storage on physical hard disk		
	Please choose whether the new virtual hard disk file should grow as it is used (dynamically allocated) or if it should be created at its maximum size (fixed size).		
	A <b>dynamically allocated</b> hard disk file will only use space on your physical hard disk as it fills up (up to a maximum <b>fixed size</b> ), although it will not shrink again automatically when space on it is freed.		
	A <b>fixed size</b> hard disk file may take longer to create on some systems but is often faster to use.		
	Dynamically allocated		
	○ Fixed size		
	Next Cancel		



**Step 8:** Put a name for your virtual HDD file and select the disk size for your VM  $\rightarrow$  Click on "Create".

	?	×
← Create Virtual Hard Disk		
File location and size		
Please type the name of the new virtual hard disk file into the on the folder icon to select a different folder to create the file	box be in.	ow or click
tutorialspoint.com		
Select the size of the virtual hard disk in megabytes. This size amount of file data that a virtual machine will be able to store	is the lin on the l	mit on the hard disk.
	_	25.00 GB
4.00 MB 2.00	ТВ	
Create		Cancel


			?	×
-	Create \	firtual Machine		
	Name an	d operating system		
1	Name:	Tutorialspoint.com		
2	Type:	Microsoft Windows	•	1
3	Version:	Windows 8 (64-bit)	-	0
	Hard disk			
1	Hard disk	ot add a virtual hard disk		
	Hard disk	ot add a virtual hard disk te a virtual hard disk now		
	Hard disk Do n Crea Use	ot add a virtual hard disk te a virtual hard disk now in existing virtual hard disk file		
	Hard disk O Do n O Crea O Use A	ot add a virtual hard disk te a virtual hard disk now an existing virtual hard disk file AC2.vdl (Normal, 25.00 GB)	3	

All the above steps can be done in one shot by selecting the "Expert mode".

The virtual machine created will be as shown in the screenshot below.

File Machine Help		23
🔵 🥹 🧄 🀳 .		😡 Detalin 🛛 Snepshots
AC2 (Snapshot 4)	General Name Extensioner.com	Preview ^
Kalk 2016.1 (Snapshot 1)	Cpersting System: Windows 7 (64-bit)  System	
Powered Off	Base Menory: S12 MB Boot Onder: Roppy, Optical, Hard Dak Acceleration: VT-v(IMD-4, Nested Paging, Hyper-4 Panavirtualization	tutorialspoint.com
2012 G Povered Off		
	E Display	
	Video Menory: 33 MB Remark Desitap Server: Disabled Webs Capture: Disabled	
	G Storage	
	Controller: SATA SATA Port 3: totonalopoint.com.vd (Nermal, 12.05 GE) SATA Port 1: [Optical Drive] Engly	
	🖗 Audio	
	Host Driver: Windows DirectSound Controller: Intel HD Audio	
	🛃 lietuork	
	Adapter 3: Intel PRO(3000 MT Desktop (HAT)	
	Serial ports	
	Disabled	
	Ø US8	
	USB Cantroller: OHCL Device Filters: 0 (D active)	
	G Shared lokiers	٦.



## Setting up Networking with VirtualBox

There are two types of networking modes in VirtualBox, which are -

- Nat Networks and
- Host-only Networks.

Both of these are explained in detail below.

#### **Nat Networks**

For setting up Nat Networks, we should follow the steps given below.

**Step 1:** Go to Oracle VM VirtualBox Manager  $\rightarrow$  Click on "Preferences..."



Step 2: Click on "Network" and then on the left panel click on the "NAT Networks" tab.

General	Network	
> Input	NAT Networks Host-only Networks	
😏 Update	Active Name	10
🗿 Language	NatNetwork	
Display		a
Network	1	
Extensions	s	
Proxy		



General	Network					
Input	NAT Networks	Host-only	Networks			
Update	Active Nam	ne				
Language	Nati	Network				
Display						0
Network				Lists all ava	ilable rks	
Network Extensions				Lists all ava NAT netwo	ilable rks.	

**Step 3:** Click on the "+" button, which is highlighted in the screenshot below.

**Step 4:** Here, we have to put the "Network Name" and the IP range for this network that will be NAT-ed, in order to have access to internet and to other networks.

NAT Network De	tails	?	×	
Enable Network			_	
Network Name:	NatNetwork1			19
Network CIDR:	10.0.2.0/24			
Network Options:	Supports DH	ICP		Ø
	Supports IP	v6		
	Advertise De	efault IPv6 R	oute	
	Port Fo	orwarding		
	ОК	Can	cel	



#### **Host-only Networks**

For setting up Host-only Networks, we should follow the steps given below.

**Step 1:** If you click on the "Host-only Networks" tab, you can create networks that are isolated from the other networks. However, VM hosts communicate with each other and the Hypervisor machine. Click on the "+" sign.

General	Network			
Input	NAT Networks	Host-only Network	ks	
J Update				R
J Language				2
Display				6
Network				
Extensions				
Proxy				

**Step 2:** The host interface will continue to be created as shown in the screenshot below.

General	Network	
🔷 Input	NAT Networks Host-only Networks	
😏 Update	Networking: Creating host only network interf ×	R.
Languag		1
Display	Creating host only network interface	a a a a a a a a a a a a a a a a a a a
P Network		
Extension	5	



General	Network	
Input	NAT Networks Host-only Networks	
😏 Update	VirtualBox Host-Only Ethernet Adapter #3	2
📀 Language		
Display		0
Network		
Extensions		

**Step 4:** If you want your host machines to take "DHCP IP", click on the "DHCP Server" tab and check the box "Enable Server"  $\rightarrow$  Click "OK".

🔗 Host-on	ly Network Det	ails		?	×
Adapter	DHCP Server				
Enable	Server				
S	Server Address:	192.168.1.1			
	Server Mask:	255.255.255.0			
Lower	Address Bound:	192.168.1.100			
Upper /	Address Bound:	192.168.1.199			
			OK	Cance	
			U	Conce	



Step 3: If you click on L

button, you can edit the settings.

Adapter	DHCP Server	
	IPv4 Address:	192.168.1 1
IF	v4 Network Mask:	255.255.255.0
	IPv6 Address:	
IPv6 Net	work Mask Length:	

**Step 5:** In the "Adapter" tab, put the IP of the hypervisor.

After all these preparations for setting up the network modes is complete. It is now time to assign a network to our VMs.

To do this, Click on the VMs on the left side of the panel, then right click on the "Network" option and a table will be open.

tutoralspoint.com	📴 Display
	Video Memory: 18 MB Remote Desktop Server: Disabled Video Capture: Disabled
	Storage
	Controller: SATA SATA Port 0: tutorialspoint.com.vdl (Normal, 10.00 GB) SATA Port 1: [Optical Drive] Empty
	🗭 Audio
	Hast Driver: Windows DirectSound Controller: Intel HD Audio
	🗊 Network 🔶
	Adapter 1: Intel PRO/1000 MT Desktop (NAT)
	Serial ports
	Disahleri

You can have up to four Ethernet adaptors per machine. The following image has four sections highlighted, which are explained below.

- 1. Check the box "Enable Network Adapter" to enable the vNIC on the VM and attach it to one network.
- 2. You can have many networks created, so we have to select one of them in the "Name" dropdown box.
- 3. In the adapter type dropdown-box, we have to select a physical NIC that the hypervisor has.
- 4. Promiscuous Mode: Here, we can select "Deny", if we do not want the VMs to communicate with each other.



🤪 tutorialspoint.com -	Settings	?	×
General	Network		
System	Adapter 1 Adapter 2 Adapter 3 Adapter 4		
Storage	2 Name: NatNetwork1		-
Network	3 Adapter Type: Intel PRO/1000 MT Desktop (82540EM)     4 Promiscuous Mode: Deny		•
USB	MAC Address: 080027D34107		9
Shared Folders	Port Forwarding		
	ОК	Cancel	ielp

Once all the above parameters are completed. Click on "OK".

## Allocating Processors & Memory to a VM

To allocate processors and memory to a virtual machine using VirtualBox, we should follow the steps given below.

**Step 1:** To allocate a processor and memory, you have to click on "Settings" after you have selected the VM.





**Step 2:** Click on "System" on the left side tab, then click on the "Motherboard" tab. Move the arrow left or right to allocate the memory as shown in the screenshot below.

-	General	System		
1	System	Motherboard Processor Acceleration		
	Display	Base Memory:	512 MB	\$
	Storage	4 MB 819	2 MB	
	Audio	Boot Order: Floppy 🐑		
P	Network	Network		
Þ	Serial Ports	Chipset: PIIX3 👻		
9	USB	Pointing Device: USB Tablet 👻		
-	Chaund Colders	Extended Features: G Enable I/O APIC		
	Shared Polders	Enable EFI (special OSes only)		
	User Interface	Hardware Clock in UTC Time		

**Step 3:** To allocate processors, click on the "Processor" tab. Move the arrow left or right to allocate the number of processors as shown in the screenshot below.

	Gustan	0.65	6
System Display Storage Audio	Notherboard Processor Acceleration Processor(s): 1 CPU Execution Cap: 1% 100	1 35 1009 %	** Xe
<ul> <li>Network</li> <li>Serial Ports</li> <li>USB</li> <li>Shared Folders</li> <li>User Interface</li> </ul>	Extended Features: Enable PAE/NX		
	OK Cancel	He	slp



General	System	
System	Motherboard Processor Acceleration	
Display	Processor(s):	1
Storage	1 CPU 4 CP	Us
Audio	Execution Cap: 1% 100	100% C
Network	Extended Features: Enable PAE/NX	
Serial Ports		
S USB		
Shared Folders		
User Interface		

**Step 4:** After all those changes are done  $\rightarrow$  click on "OK".

## Duplicating a VM Using VirtualBox

To duplicate a virtual machine using VirtualBox, we should follow the steps given below.

**Step 1:** To duplicate a VM that we created before, right click on the VM and select "Clone". A wizard will open.

	indimerco			Display						
1.115	0	Settings_	Ctrl+S	Video Nemary 12 MB						
	G	Clone	Ctrl+O	Remote Desktop Serveri Disabled Video Campare: Disabled						
	RemoveCtrl=R		Ctrl-R	Storage						
	68	Group	Ctrl+U							
	4	Start		Controller: SATA SATA Port 0: tutonalopoint.com.vdl (Narmal, 18.00 GB)						
	1.00	Paure	Ctrl+P	Perine April 11. Foldone numbel tradich						
	0	Reat	Ctrl=T	P Audio						
	$\forall$	Clese		Host Driver: Windows DirectSound Controller: Intel HD Audio						
	4	Discard Saved State	Cori+J	🛃 Betwork						
	01	Show Log	Ctrl+L	Adapter 1: 3ntel PRO/1000 MT Desktop (VAT Network, NadVetwork1)						
	100	and the second		🖉 Serial ports						
	-	Show in Explorer		Disibled						
	~	Create shortcut on Deskt	op	🥔 USB						
	88	Sort		USB Controller: CHCI Device Filters: 0 (0 active)						



Step 2: Write the name of the cloning machine and click on "Next".



Step 3: Select one of the options and Click on "Clone".







**Step 4:** The newly created VM will be as shown in the following screenshot.

## Deleting a VM on VirtualBox

To delete a virtual machine on VirtualBox, we should follow the steps given below.

**Step 1:** To start with, we have to right click on the VM that we want to delete and then click on "Remove".

E Intern	Repoleit.com Close		Video Memory: 13 MB Remote Desktop Server: Disabled
	<ul> <li>Settings</li> <li>Clone</li> </ul>	Ctrl+S Ctrl+Q	Storage
	Remove	Ctrl+R	Controller: SATA SATA Port 0: tutorialspoint.com Clone.vdl (Normal, 10.00
	Croup	Cbi+U	SATA Port 1: [Optical Drive] Empty
	III Pause Ctrl+P		Host Driver: Windows DirectSound Controller: Intel HD Audio
	⊙ Reset ⊽ Close	Ctrl+T P	Network
	Discard Saved State	Ctrl+)	Adepter 1: Intel PRO/1000 MT Desktop (NAT Network, NatVe
	🛐 Show Log 💮 Refresh	Ctrl+L	Serial ports Disabled
1	Show in Explorer		
	Create Shortcut on Deskto	P	Device Filters: 0 (0 active)
Add new group	Sort based on selected virtual mach	nines	Shared folders







# 8. Virtualization – Openstack

In this chapter, we will discuss regarding Openstack and its role in Virtualization.

## Understanding Openstack

OpenStack is a software for building and managing cloud-computing platforms for public and private clouds. Openstack has one of the biggest communities. It is managed by the <u>OpenStack Foundation</u>, a non-profit organization that oversees both development and community building. Its official webpage is – <u>https://www.openstack.org/</u>.

OpenStack is used to deploy virtual machines and other instances that handle different tasks for managing a cloud environment. OpenStack is considered as – Infrastructure as a Service (IaaS). Based on Openstack, please see the following schematic illustration, which describes how it is managed.



#### Source: https://www.openstack.org/



Openstack platform is managed by a web UI dashboard. It comprises of nine Core key components.



These key concepts are described in detail as follows:

- **Nova** is a computing engine. It is used for deploying and managing large numbers of virtual machines.
- **Swift** is a storage system for objects and files.
- **Cinder** is a block storage component. It accesses specific locations on a disk drive.
- **Neutron** provides the networking capability.
- **Horizon** is the dashboard of Openstack. It is the only graphical interface (WEB UI).
- **Keystone** provides identity services. It is essentially a central list of all the users.
- **Glance** provides image services to OpenStack. In this case, "images" refers to images (or virtual copies) of hard disks.
- **Ceilometer** provides telemetry services, which allow the cloud to provide billing services to individual users of the cloud.
- **Heat** allows developers to store the requirements of a cloud application in a file that defines what resources are necessary for that application.

The release versions of Openstack are explained in the following illustration.



Release Name	Release Date	Components Included
Austin	October 2010	Nova, Swift
Bexar	February 2011	Nova, Glance, Swift
Cactus	April 2011	Nova, Glance, Swift
Diablo	September 2011	Nova, Glance, Swift
Essex	April 2012	Nova, Glance, Swift, Horizon, Keystone
Folsom	September 2012	Nova, Glance, Swift, Horizon, Keystone, Quantum, Cinder
Grizzly	April 2013	Nova, Glance, Swift, Horizon, Keystone, Quantum, Cinder
Havana	October 2013	Nova, Glance, Swift, Horizon, Keystone, Quantum, Cinder, Ceilometer, Heat
Icehouse	April 2014	Nova, Glance, Swift, Horizon, Keystone, Quantum, Cinder, Ceilometer, Heat, Trove
Juno	October 2014	Nova, Glance, Swift, Horizon, Keystone, Quantum, Cinder, Ceilometer, Heat, Trove, Sahara
Kilo	April 2015	Nova, Glance, Swift, Horizon, Keystone, Quantum, Cinder, Ceilometer, Heat, Trove, Sahara, Ironic

## **Installing Openstack**

As Openstack is an open source platform, there are many ways to install and deploy it through different software distributions. Each one of them adds their own value to the cloud operating system.

For a new system administrator, who wants to play with Openstack will get pre-installed ISO images of the Openstack platform. They can be downloaded from the following link – <u>http://docs.openstack.org/image-guide/obtain-images.html</u>



To install them manually, the main distributors are:

- Ubuntu: https://www.ubuntu.com/cloud/openstack
- Red Hat: <u>https://www.rdoproject.org</u>
- **Suse**: <u>https://www.suse.com/products/suse-openstack-cloud/</u>



We must understand that Openstack is for enterprise environment and to install it we should have the following hardware requirements.

#### **Installation Requirements**

The installation requirements for Openstack are as follows:

- A minimum of 5 machines with the following roles:
  - 1 machine for the MAAS server.
  - 1 machine for the Autopilot.
  - 3 or more machines for the cloud:
    - At least one must have 2 NICs.
    - At least 3 must have 2 disks.
- A dedicated switch to create a private cloud LAN.
- Internet access through a router on that LAN.

For this laboratory, we have a virtual machine and we will install **Devstack**. It is designed for installation on a single laptop, PC or VM. It includes the raw upstream code for development evaluation. It is supported on –

- Ubuntu 14.04/16.04
- Fedora 23/24
- CentOS/RHEL 7
- Debian and
- OpenSUSE.

The link for this version is – <u>http://docs.openstack.org/developer/devstack/#install-linux</u>

### Installing Openstack on Ubuntu 14.04

For installing Openstack on Ubuntu 14.04, we should follow the steps given below.

**Step 1:** Download the installation script from the following link – <u>https://git.openstack.org/cgit/openstack-dev/devstack</u>.

Use this command – *git clone https://git.openstack.org/openstack-dev/devstack* 

#### :--\$ git clone https://git.openstack.org/openstack-dev/devstack

```
Cloning into 'devstack'...

remote: Counting objects: 26862, done.

remote: Compressing objects: 100% (12384/12384), done.

remote: Total 26862 (delta 19136), reused 21637 (delta 14215)

Receiving objects: 100% (26862/26862), 5.30 MiB | 1.22 MiB/s, done.

Resolving deltas: 100% (19136/19136), done.

Checking connectivity... done.
```



**Step 2:** Browse the folder Devstack by keying in the following command – **\$ cddevstack**.

-6300-MT:~\$ cd devstack/

**Step 3:** Execute the file **stack.sh** with the following command **./stack.sh** and installation process will continue as shown below:



Step 4: Enter your password.

ENTER A PASSWORD TO USE FOR RABBIT. This value will be written to your localrc file so you don't have to enter it again. Use only alphanumeric characters. If you leave this blank, a random default value will be used. Enter a password now:



**Step 5:** Now it will take about 15-20 minutes to finish the installation process, while it downloads and installs all the libraries.

Get:7 http://in.archive.ubuntu.com/ubuntu/	trusty/main libgfortrans ando4 4.8.2 19ubudtu1 [250 k8]
Get:B http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main libgssrpc4 and64 1.12+dfsg-2ubuntu5.1 [53.1 k8]
Get:90http://in:archive:ubuntu.com/ubuntu/	trusty-updates/main libkadm5clnt-mit9:and64/1:12+dfsg-2ubuntu5:1/[36.1
Get:10 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main libkdb5+7 and64 1.12+dfsg+2ubintu5.1 [30.2 k8]
Get:11 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main libkadn5sru-mit@ ando4010122+dfsg-2ubuntu5.10[50:30
Get:12 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main hysgl:common all 5.5.43:Oubuntu0.14:04.1 [13.8 k8]
Get:13 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/nain libnysglclient18 and64 5.5.43-Bubuntu0.14.04.1 [59
Get:14 http://in.archive.ubuntu.com/ubuntu/	trusty/main libocrecopd and64 1:0.31/20bontc2 [14:5 kB]
Get:15 http://in.archive.ubuntu.com/ubuntu/	trusty/main libexpati-dev emdo4 2:1:0:40buntu1 [115 k8]
Get:15 http://in.archive.ubuntu.com/ubuntu/	trusty/main liboython2u7-dev andd4-207.6-8 [22.0 M8] 4.00.1 [1027.40]
Get:17 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main librados2 and64 0:00.9-Oubuntu0:14:04.1 [1427 k8]
Get:19 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main librod1 and64 0.00.9-Oubuntu0.14/04.1/[318 k8]
Get:19 http://in.archive.ubuntu.com/ubuntu/	trusty/mainilibsyifs2 and64 2.1.0+repack=Jubuntui[19.3 k8] ks
Get:20 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/hain_ltbyanl-0-2 and64 0.1.4-Bubuntul:1 [48.1 k8]
Get:21 http://in.archive.ubuntu.com/ubuntu/	trusty/nata python=n2crypto amd64 0.21.1=3ubuntu5 [156 kB]
Get:22 http://in.archive.ubuntu.com/ubuntu/	trusty/updates/main_tcpdump_amd64_4.511-2ubuntu1.2 [355 kB]
Get:23 http://in.archive.ubuntu.com/ubuntu/	trusty/main=bridge=utils=amd64=1:5=6ubuntu2=[29:2[kB]: ND]
Get:24 http://in.archive.ubuntu.com/ubuntu/	trusty/universe constrack and64 1:104:1-10bunt01 [25.1 k8]
Get:25 http://in.archive.ubuntu.com/ubuntu/	trusty/maim_dnemdsq=uttls_amd64_2L68-1[[7972_8]]
Get:26 http://in.archive.ubuntu.com/ubuntu/	trusty/unlverse-dstat/all/0.7/2-3builds/(68:2/k8)//////
Get:27 http://in.archive.ubuntu.com/ubuntu/	trusty/malm-ebtables_and64_2.0110.4=3ubuntu1 [77.5 kB]
Get:20 http://in.archive.ubuntu.com/ubuntu/	trusty/universe fping and64-3.8-10[38.7 kB]00000101 [10000 kB]
Get:29 http://in.archive.ubuntu.com/ubuntu/	trusty/main libstdc+e-4.8-dev and64:4:8:2-19ubuntu1 [1050 kB]
Get:38 http://in.archive.ubuntu.com/ubuntu/	trusty/main g++-4.8 and64 4.8.2-19ubuntu1 [7038 k8]
Get:31 http://in.archive.ubuntu.com/ubuntu/	trusty/main_g++-and64_4c418.2=10bunt06_[1490_B]+0.1_[23.3_00]
Get:32 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main libcdt5_and64/2:36.0+Oubuntu3:1 [23,3 k8] 0
Get:33 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main libcgraph6 and64 2.36.0.0ubuntu3.1 [44.1 k8]
Get:34 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main libpathplan4/and64 2.36.0+0ubunt03:1 [26.3 kB]
Get:35 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main libgvc6_and64-2.36.0+0ubuntu3.1.[576.kB]
Get:35 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main libgvpr2 and64 2.30.0-0ubuntu3.1 [169 kB]
Get:37 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main graphviz and64 2.36.0-Oubuntu3.1 [461 k8]
Get:39 http://in.archive.ubuntu.com/ubuntu/	trusty/mataljavascript-common all/11 [6866 B]. 4 Johnstol 7 [38.3 KB]
Get:39 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main comerr-dev.amd64.2.1.1.42.9.3ubuntu1.2 [38.3/kB]
Get:40 http://in.archive.ubuntu.com/ubuntu/	trusty-updates/main krb5-multidev and64 1.12+dfsg-2ubuntu5.1 [111 k8]
Get:41 http://in.archive.ubuntu.com/ubuntu/	trusty/main libblas3 and64 1.2.20110419-7 [215 kB] 6 6 66
Get:42 http://in.archive.ubuntu.com/ubuntu/	trusty/main libjs-jquery all-1.7.2+dfsg-2ubuntu10[78.8 kB]
Get:43 http://in.archive.ubuntu.com/ubuntu/	trusty/main libjs-jquery-metadatamail=8+20(6856-8)
Get:46 http://in.archive.ubuntu.com/ubuntu/	trusty/main llbjs=jquery-tablesorter_all 8+2 [64.0 kB]
Get:45 http://in.archive.ubuntu.com/ubuntu/	trusty/main libiapack3 amdo4 3.5.0-2ubuntu1 [1730 kB]
Get:40 http://in.archive.ubuntu.com/ubuntu/	trusty/main ziibig-dev and64 1:1.2 8.drsg-lubuntul [183 kB]

**Step 6:** At the end of the installation, we will see the IP of the host, URL for managing it, username and password to administrate it.

This is your host ip: 192.168.2.3 Horizon is now available at http://192.168.2.3/ Keystone is serving at http://192.168.2.3:5000/ The default users are: admin and demo The password:



🕘 🗃 http://localhost/	/의 • X O localhost 명기 용 ×
	openstack b
	openstack
	Login
	Log m
	User Name:
	demo
	Password:
	Sägn In

**Step 7:** To sign in, you have to type in the browser: Host IP, username and password that we entered during the installation.

**Step 8:** In the main dashboard, you will see "Instances" overview.

e i B htt:/ localto	a'sont'	P-0 8m	ance Overview - OpenS., ×			n e
D openstack	6	demo *				ann 🚛 - Sip Out
Project		Overview				
Compute	- 28	Limit Summary				
Overview						
Instances						( <b>*</b> )
Volumes						
Images		, Instances	VCPUs	RAM	Floating IPs	Security Groups
Access & Security		Used 0 of 10	Used 0 of 20	Used 0Bytes of 50.9G8	Used 0 of 50	Used 1 of 10
Network.						
Orchestration						
		Volumes	Volume Storage	1		



**Step 9:** To create new instances or in simple words to create Virtual machines click on "Instances".

Die openstack		demo 👻			
Project		Overview			
Compute		Limit Summary			
Overview					
interces					
Volumes					
Imagen		Instances	VCPUs	RAM	Floating IPs
Access & Seculty		Used 0 of 10	Used 0 of 20	Used OBytes of 50.0GB	Used 0 of 50
Network	. 1				
Orchestration					

Step 10. Click on "Launch Instances".

D openstack		dens 1									-1-	Sign Out
Project	14	Instances										
Compute	. *	Instances						Film		Q 700	+100	ch betwee
Overview		Instance Name	Image Name	IP Address	Sau	Neg Pair	Status	Availability Zone	Task	Power State	Uptime	Actions
Instances						No item	to display					
Volumen		Distance 2 lives										
Images												



Post-Creation	
	Advanced Options
Specify the details	for launching an instance
The chart below sh	ows the resources used by
in relation to the pro	oject's quotas.
Name	m1.micro
VCPUs	1
Root Disk	0 GB
Ephemeral Disk	0 GB
Total Disk	0 GB
RAM	128 MB
Project Limits	
Number of Instance	ces
Number of VCPUs	
	Specify the details The chart below shi in relation to the pro- Flavor Details Name VCPUs Root Disk Ephemeral Disk RAM Project Limits Number of Instance Number of VCPUs

**Step 11:** Fill in all the fields as shown below.

**Step 12:** We will see the instance created as shown in the following screenshot.

Inc							0	-			(Concession)	The second second
ins	cances						ų	THE	+ Lounch	tostance.	124 1000	The second se
0	Instance Name	Image Name	gp Address	Size	Key Pair	Status	Avail Zone	ability	Task	Power State	Uptime	Actions
0	-	cinos-0.3.1-x85_64- vec		ert.micro   125M8 RAM   1 VCPU   0Bytes Disk	*	Build	nova		Scheduling	No State	0 minutes	Associate Floating IP Mane 1
Depis	ying 1 liters								4			



Virtualization, at least at the server level, has been in use for some time. Since, the concept has expanded to the User, Application, Network, Security, Storage, and of course to Desktop Virtualization (VDI) as well. Therefore, to roll out in all these concepts, we have to prepare an infrastructure before, which is divided in some key components.

The First one is **Hypervisor** and we have discussed it in the earlier chapters. Some important specifications needed for this job are – Processors, Memory and Networking Modes, etc.

#### **Networking - LAN and WAN Optimization**

VDI can be very resource intensive – this includes traffic over the wire. Having a good **core-switching infrastructure** will help alleviate this pain by allowing the administrators to create certain rules and policies revolving around traffic flow.

Setting up **QoS metrics** for VDI-specific traffic can help remove congestion and ensure that the right traffic has the proper amount of priority. As for the traffic that is leaving the data center, knowing where the user is located and optimizing their experience based on certain criteria, becomes very important.

Another significant aspect is storage. Large organizations will have numerous storage controllers. At the same time, some smaller organizations will be using only one. Regardless of the amount of storage controllers available, they need to be sized properly for VDI.

To prevent boot and processing storms, organizations must look at IOPS requirements for their images. To alleviate processing pains, administrators can look at **Flash Technologies** (**NetApp**, **Fusion-IO**, **XtremIO**) or **SSD Technologies** (**Violin**, **Nimbus**) to help offload that kind of workload. Furthermore, intermediary platforms like **Atlantis ILIO** run on top of a virtual machine that utilizes massive amounts of RAM as the key storage repository.

## **Understanding Different File Systems**

File systems are varied depending on their functions. Some of the most common ones are listed below:

- Virtual Machine File System- VMFS
- Network File System- NFS
- New Technology File System- NTFS
- Raw Device Mapping- RDM

Let us discuss each of these in detail.

#### Virtual Machine File System

**VMFS** is a file system proprietary to VMware. It is a clustered file system and it can be mounted on multiple servers simultaneously. This helps every host to connect to the any file system at the same time, which is expected from a proprietary system preferred by



VMware. Most of the VMware hypervisors will work with other file systems, but the default choice and the preferred choice is VMFS.

#### **Network File System**

NFS is a system that was originally developed by Sun, but is now an Open Standard system. Used commonly in the UNIX and Linux world. It is a distributed file system. It can be mounted on one server and the network will be used to share information to multiple machines.

#### **New Technology File System**

NTFS is the standard file structure for the Windows NT operating system. It is used for retrieving and storing files on the hard disk.

#### **Raw Device Mapping**

RDM helps any file in a virtual machine file system to act as a proxy for any raw device. It allows a VM to access as well as use the storage device.

## **Choosing Between Different Types of Storage**

All the storage devices are divided into three categories, which are -

- Direct-Attached Storage
- Network-Attached Storage
- Storage-Area Network

Let us understand each of these in detail.

#### **Direct-Attached Storage**

DAS is your local hard drive. We can have one or more local hard drives in every machine. It is mostly used for small-virtualized systems. This solution is appropriate for a small amount of guest machines. It is the cheapest and the easiest method of storage. You can connect an external hard drive too with this method, load any guest machines onto that external hard drive, and that is just a quick and easy way to get rolling.

For example – A server that has local hard discs on it. That type of hypervisor can hold not more that 10-20 VM machines. A sample device can be a HP Server with eight local hard discs as shown in the following illustration.





#### Network-attached Storage

NAS is "Any server that shares its own storage with others on the network and acts as a file server in the simplest form". Network Attached Storage shares files over the network. Some of the most significant protocols used are **SMB**, **NFS**, **CIFS**, and **TCP/IP**. When you access files on a file server on your windows system, it is NAS.

NAS will be using an Ethernet connection for sharing files over the network. The NAS device will have an IP address and then will be accessible over the network through that IP address. Biggest providers of NAS are **QNAP** and **Lenovo**.



The following illustration shows how NAS works.





#### **Storage-area Network**

SANs allow multiple servers to share a pool of storage; making it appear to the server as if it were local or directly attached storage. A dedicated networking standard, **Fibre Channel**, has been developed to allow blocks to be moved between servers and storage at high speed. It uses dedicated switches and a fiber-based cabling system, which separates it from the day-to-day traffic traversing the busy enterprise network. While the well-established SCSI protocol enables communication between the servers' host bus adaptors and the disk system.



The following illustration shows how a SAN switch operates.





# **10.** Virtualization – Troubleshooting

In this chapter, we will discuss troubleshooting for network communication and for slow performance.

## **Troubleshooting Network Communication**

In a virtual environment, to troubleshoot a network connectivity, we should follow some steps in order to find a resolution.

#### **Network Communication Indications**

Some of the symptoms that we have are as follows:

- You cannot connect to the Internet.
- There is no network connectivity to or from a single virtual machine.
- Virtual machines fail to connect to the network.
- Cannot get an IP.
- A TCP/IP connection fails to and from a single virtual machine.

#### **Network Communication Errors**

You can get the following errors as well:

- Destination Host Unreachable
- Network error
- Connection Refused
- Network cable is unplugged
- Ping request could not find host
- Please check the name and try again
- Unable to resolve target system name, etc.

#### **Network Communication Resolutions**

The resolutions for the above symptoms and errors are as follows -

- Make sure that the **Port Group Name** is associated with the virtual machine's network adapter, which exists in the switch or in the Virtual Distributed Switch. Also, ensure that it is spelt correctly.
- Make sure that there are enough **storage capacities** in your virtual machine sometimes it affects the connectivity.
- Verify that the **virtual network adapter** is present and connected.



- Verify that the networking within the virtual machine's **guest operating system** is correct.
- Verify that the **TCP/IP stack** is functioning correctly.
- If this virtual machine was converted from a physical system, verify that there are no **hidden network adapters** present. Because it can have hidden static routes.
- Verify that the **vSwitch** has enough ports for the virtual machine.
- Verify that the virtual machine is configured with two **vNICs** to eliminate a NIC or a physical configuration issue.
- Confirm that your virtual machine's **firewall** is not blocking the Internet access.
- Confirm that your virtual machine's **anti-virus program** is not blocking the Internet access.
- Ensure that the **network adapter** is enabled.
- Shut down the virtual machine and then restart your **Host Machine**.
- Removing and re-adding virtual network card adaptor.

### **Troubleshooting Slow Performance**

Check if your CPU load is high. You can click on "CPU". This will show you the amount of CPU the VM is consuming. If it is very high, you may consider adding some more vCPUs. This should be done after ensuring that the physical host has more cores available than what you are going to configure inside the VM. We should also consider whether the applications inside the VM are actually able to utilize multiple vCPUs or not.

#### **Check the Memory**

Memory could be a serious limit on VM performance as well. If you do not configure enough memory, the VM will usually respond by starting to swap its memory pages to disk .If your virtual machine is using more than 2/3rd of the memory and then we should allocate more.

#### See Disk Alignment

For any pre-Windows 7, pre-Windows 2008 Server or older Linux based systems, your disks may be misaligned. Misalignment may cause quite a performance hit, especially when your storage underneath does not have many IOPS to spare.

It is important to format the virtual disks to a specific format or block size according to the application needs. For example – The database of a Microsoft SQL 2005 server is generally put on an NTFS that has a block size of 64KB.

If the virtual machine has a performance issue at some point in time, you need to check the virus scanner. Not only on the impacted virtual machine, but also on the other virtual machines as well.

If you do a P2V – a virtual machine (meaning you convert a physical machine to a VM) and you do not "clean up" afterwards, there may be a lot of unused drivers and even applications.



In this chapter, we will discuss how to back up, restore and migrate a virtual machine.

## Duplicating a VM

To duplicate or clone a machine means making an exact copy of it. Most of the hypervisors support this feature. By duplicating a machine, we copy down every detail, including the name of the machine and the different network addresses attached to the machine.

Duplicating a machine and putting it in to function is not always the best option because a duplicate name or IP in network can be a problem. We make duplication generally for backup purposes.

Most hypervisors can clone while the machine is turned off. If the hypervisor accepts to clone while it is on, it is recommend to turn it off, because the process can crash the machine. In practice, we have discussed "How cloning is done in VMware Workstation", please refer to the previous chapters.

## **Backing Up and Recovering a VM**

There are three methods for backing up virtual machines.

### Method 1

The most common one is to install traditional backup software on the guest VM. If Windows OS is used on our VM, we can use "Backup and restore" to back up the machine, which is found in the "Control Panel".



For Linux OS, we can use many open source tools depending on our needs, like "Bacula", "rsync", etc.



#### Method 2

Another strategy or method is to copy all of the files that define a VM. Therefore, we will have to go out and find all of the individual files that define our virtual machine and copy them to an alternate location. Some of these files are going to be large.

Example: Here, we have created several VM machines with VirtualBox as shown in the following illustration. Their names are – "AC2", "Kali2016.1", "test", "Windows 2012".

Oracle VM VirtualBox Manager File Machine Help
New Settings Discard Start
AC2 (Snapshot 4)
Kali 2016.1 (Snapshot 1) Overed Off
Powered Off
Windows 2012 Operation of the second

To find the files that we have to copy or to backup, we have to right click on the VM machine. Go to "Storage" then move your mouse over the virtual HDD and it will show the full path where the VDI files are found.

AC2 (Snapshot 4)	(B					
2008 Saved	Windows 2012 - Settings ?					
Kali 2016.1 (Snapshot 1)	E General Storage					
77 Sovered Off	System Storage Tree	Attributes				
Windows 2012	Display Controler: SAIA CO	Type: AHCI V				
	<ul> <li>Joonege</li> <li>Audio</li> <li>Network</li> <li>Senial Ports</li> <li>USB</li> <li>Shared Folders</li> <li>User Interface</li> </ul>	alBox VMs\Windows 2012\Windows 2012.vdi				
	Tested	OK Cancel Help				



		type	242E		
Logs	9/30/2016 8:59 AM	File folder			
🜍 Windows 2012.vbox	10/28/2016 9:25 AM	VirtualBox Machin	8 KB	I	
Windows 2012.vbox-prev	9/30/2016 4:21 PM	VBOX-PREV File	8 KB	I	
😝 Windows 2012.vdi	9/30/2016-4:20 PM	Virtual Disk Image	10,212,352	I	
😵 Windows 2012.vdi	9/30/2016 4:20 PM	Virtual Disk Image	10,212,352		

We will save all these files to another location.

#### Method 3

The third option to backup and restore VM machines is to use third party software. One of the best is **VEEAM**, which can be found on the following URL – <u>https://www.veeam.com/</u>



## Converting a Physical Server into a Virtual Server

In this section, we will see how to convert a physical machine into a virtual machine. This is often called as **P2V** in many literatures.

VMware puts out a product that is called **vCenter Converter**, which will convert from a physical machine specifically into a VMware virtual machine. The software can be downloaded from – <u>http://www.vmware.com/products/converter.html</u>





Microsoft has a product called **Disk2vhd**, which will convert a physical hard drive into a VHD formatted virtual hard drive. It can be downloaded from the following link – <u>https://technet.microsoft.com/en-us/sysinternals/ee656415.aspx</u>

We just have to install the software on the physical server and click "Create" as shown in the screenshot below. A VHDX file will be created which could be imported in a Hypervisor.

VHD File name:		Use Volume Shadow Copy				
C:  Lisers \ <b>Service</b> r  Des	ktop\Disk2vhd\	vho	źx.			
Volumes to include:						
Volume	Label	Size	Free	Space Required		
✓ \V/\Volume(a0e35b25+	KINGSTON	3.73 GB	1.32 68	3.74 GB		
✓ \\?ea038e88	System Reserved	100.00 MB	66.07 MB	36.01 MB		
✓ C:\	[No Label]	195.22 GB	54.82 G8	116.10 GB		
D:\	[No Label]	270.45 G8	184.70 G8	26.59 GB		



Both of these products will convert machines, while the server is running and is free. All the vendors of hypervisors have some P2V tool and they are typically free. From the vendor's point of view, they would very much like you to convert your physical machines into virtual machines that are optimized for their hypervisor.

## Converting a Virtual Server into a Physical Server

To convert a virtual server to a physical server also commonly called as V2P is certainly less common than a P2V conversion. However sometimes, it is needed in development-based environments. It does happen where a product needs to be tested in the virtual server than to a physical server, or to clone a production machine and move it to test.

Hypervisor vendors do not offer such a tool. However, you have to request the hardware vendor, if they could offer such tools.

