



Nutanix Community Edition ON VMWARE ESXI 6.0

Name | Date

Contents

Executive summary
Legal Information
Audience
Objectives
Pre-Requisites
Other recommendations
Community Edition Licensing Requirements
Access to Community edition
Signup
Download5
Deploy
How to bypass memory, SSD and its size requirements
Getting started
Step 1: Enable SSD7
Step 2 Enable nested virtualization
Step 3 Download Nutanix ce
Step 4 Enable promiscuous mode
Step 5 Upload vmdk10
Step 6 Prepare to create VM
Step 7 Create VM12
Step 8: Power on the VM and install nutanix ce
Configuring a Nutanix CE cluster
Install an SSH client:
SSH under Linux
Single-node and Multi-node clusters
Create a single-node cluster
Create a multi-node cluster
Starting and stopping services
Starting
Stopping

Powering off a whole cluster

Executive summary

Nutanix Community Edition is a free version of Nutanix AOS, which powers the Nutanix enterprise cloud platform. The Community Edition of AOS is designed for people interested in test driving its main features on their own test hardware and infrastructure. As stated in the end user license agreement, Community Edition is intended for internal business operations and non-production use only.

Before you begin, consider that the commercially-available Nutanix NX Series systems are tuned for performance. The enterprise-ready version of AOS is bundled as the engine driving our hyper converged compute and storage platform. You should not expect to achieve comparable benchmark numbers. For example, the NX Series systems include 10 GbE network interfaces, high core count dual CPUs, large amounts of memory, and high-performance enterprise-class solid-state drives (SSDs).

Test drive and experience the technology that powers the world's largest datacenters, at no cost. Hyperconverged Test Drive enables IT administrators and tech enthusiasts to fully experience the power of the Nutanix Enterprise Cloud Platform. Go beyond hyper-converged infrastructure and get hands-on experience with the Enterprise Cloud Platform that powers the world's largest datacenters.

Legal Information

- > The author assumes no liability whatsoever for any direct or indirect damage, loss, inconvenience or other unintended consequences caused by using, or following the information presented in this guide.
- Whilst great care and attention has been taken whilst producing this guide the author cannot guarantee the accuracy of any of the information provided in this guide.
- The guide and the information presented in this guide is based on the "beta" version of the product which will be subject to unspecified changes and modifications over time, outside of the author's control.
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o "NPSR – Nutanix Platform Sales Representative" o "NPSE – Nutanix Platform Sales Engineer" o "NPP – Nutanix Platform Professional" .

The only official source of product information and product support for "Nutanix Community Edition" is from the "Nutanix NEXT community".

Audience

This guide is intended primarily at IT professionals and virtualization consultants with an interest in learning and deploying "Nutanix Community Edition" in a "home-lab", "test/dev" or "non-production" environment.

The information found in this guide should not be used or followed in a production environment or live business environment, it is provided for the sole purpose of helping individuals learn "Nutanix Community Edition" in a small training environment.

Hyper-converged infrastructure enthusiasts, System Admin who would like to gain hands on experience Nutanix platform and

- ➢ IT pros
- > IT Managers
- > SysAdmins
- Storage Admin

Objectives

This document provides step by step instruction to install Nutanix CE. This primary focus of this guide is to provide the user with enough information to:

- > Download and install "Nutanix Community Edition".
- > Perform initial configuration of a 1, 3 or 4 node cluster.
- Configure Storage.
- Configure Networking.
- > Build a VM on the ESXi hypervisor.
- > Provide a basic overview of the PRISM dashboard and management interface.
- > Start, Stop and Shutdown the cluster in a controlled manner

Pre-Requisites

To Install Nutanix CE on commodity hardware following are the requirements.

- Servers 1, 3 & 4 servers
- > CPU Intel CPUs, 4 cores minimum, with VT-x support
- Memory 16GB minimum
- > Storage Subsystem RAID o (LSI HBAs) or AHCI storage sub-systems
- → Hot Tier (SSD) One SSD per server minimum, ≥ 200GB per server
- > Cold Tier (HDD) One HDD per server minimum, ≥ 500GB per server
- Networking Intel NICs
- ≻ ESXi

Other recommendations

Component	Recommendation
Cluster size	Community Edition allows you to install single-node, three-node, and four- node clusters. Depending on your available hardware, Nutanix recommends a three-node cluster to exercise the features of Community Edition most effectively.
DHCP Server	If you are using a DHCP server, ensure that static IP addresses are assigned for hypervisor hosts and Controller VMs. Nutanix recommends that you not use dynamic IP addressing for hosts or Controller VMs.
Imaging software	Linux: use the included dd utility Mac OS X: use the included dd utility Windows: <u>ImageUSB</u> from PassMark Software (freeware)

COMMUNITY EDITION LICENSING REQUIREMENTS

To use the Community Edition, Nutanix requires the following actions and access. If you fail to meet these requirements, access to your cluster will be blocked. The cluster remains operating but you will be unable to log on to it. Otherwise, there are no licensing file requirements as with the commercially-available Nutanix products.

Requirement	Enforcement
Admin account password change from default	When you first log on to the Prism web console with the admin account credentials, you must immediately change the admin user password from its default.

Requirement	Enforcement
Nutanix Next account with log on credentials and the Community Edition role enabled	After you first log on to the Prism web console and change the admin credentials, you are prompted to provide these credentials.
Outgoing TCP ports 80 or 8443 opened through your firewall	An automated feedback mechanism named Pulse that sends cluster alerts and usage statistics to Nutanix requires internet connectivity and port access.
Install any pending Community Edition updates	Nutanix make updates available occasionally. When an upgrade is available, but not yet downloaded, you must upgrade within 30 calendar days. You must install the available upgrade immediately once you have downloaded it. If you fail to meet these requirements, access to your cluster will be blocked. The cluster remains operating but you will be unable to log on to it.

Access to Community edition

SIGNUP

Sign up to access and download Community Edition software.

http://www.nutanix.com/products/community-edition/register

DOWNLOAD

Once signed up, the link to download the software can be found in this forum (registration required):

http://next.nutanix.com/t5/Nutanix-Community-Edition/ct-p/NutanixCommunity-Edition

Initial Install Image <u>ce-2017.07.20-stable.img.gz</u> 9a04da41b01db43ae6e1f31de8986057

DEPLOY

Deploy Community Edition on up to four servers using a broad variety of hardware.

http://www.nutanix.com/cwm/ce-hardware-table.html

HOW TO BYPASS MEMORY, SSD AND ITS SIZE REQUIREMENTS

How to mark a disk as SSD – In my case, I have Dell gear with PERC controllers. As some of you may know, they don't support JBOD. I my lab I just configure each drive in a single drive raid 0 with caching turned off. However, the SSD is still seen as a traditional disk. So, here is how to bypass to complete a Nutanix Install

After the image boots up, login using username "nutanix" and password "nutanix/4u"

- > type "fdisk -I' and identify which disk your SSD is. In my case it was "sdb"
- > type the following to identify if it is rotational or SSD
- cat /sys/block/sdb/queue/rotational (0 means SSD, 1 means HDD)

type the following to change the identified type

- o echo 0 > /sys/block/sdb/queue/rotational
- type the following to confirm the change
 - cat /sys/block/sdb/queue/rotational (0 means SSD, 1 means HDD)

How to bypass the SSD size requirement – In my case, my SSD was only 120GB while there is a requirement for 200gB or more. Easily handled,

- Login as root (Password "nutanix/4u")
- Change to directory /home/install/phx_iso/phoenix
- Edit minimum_reqs.py (ex. nano minimum_reqs.py) and change the two instances of "199" to whatever fits your system. In my case, I just set it to 100.

How to modify the memory size requirement

- Login as root (Password "nutanix/4u")
- Change to directory /home/install/phx_iso/phoenix
- Edit minimum_reqs.py

under "if os.environ.has_key('COMMUNITY_EDITION'):" change "MIN_MEMORY_GB = " to something below the current system inventory you are trying to install on is

How to modify the CPU core size requirement

- Login as root (Password "nutanix/4u")
- Change to directory /home/install/phx_iso/phoenix
- Edit minimum_reqs.py

under "if os.environ.has_key('COMMUNITY_EDITION'):" change "MIN_CORES = " to something below the current system inventory you are trying to install on.

Getting started

STEP 1: ENABLE SSD

Enable SSD in ESXi. It is required that SSD option need to be enabled if not detected by default. SSD drives are used for the following reasons.

Esxcli is used to enable SSD. Identify the Device name using esxcli # esxcli storage nmp device list # esxcli storage nmp satp rule add -satp=VMW_SATP_LOCAL --device naa.60026b904e7c97001ff645bb1543a0 97 --option "enable_ssd"



STEP 2 ENABLE NESTED VIRTUALIZATION

Enable Login to vmware esxi 6.0 using putty and navigate to cd /etc/vmware/config.

We have to add line at the end of file "vhv.enable = "true" to enable the nested virtualization as shown in the figure below enable nested virtualization as we are installing on top of VMware esxi

What is nested virtualization:

Nested virtualization is a virtual machine contained within another virtual machine. The real benefit here is that you can run multiple nested nodes on one physical box.



STEP 3 DOWNLOAD NUTANIX CE

Download Nutanix community edition and follow below steps

- extract the ce-2015.06.08-beta.img from the archive
- rename the ce-2015.06.08-beta.img to ce-flat.vmdk
- create disk descriptor file or download it from Joep Piscaer (<u>http://www.virtuallifestyle.nl</u>) blog here > <u>https://www.virtuallifestyle.nl/2015/06/nextconf-running-nutanix-community-edition-nested-on-fusion/</u>.
- Rename ce.txt to ce.vmdk.

STEP 4 ENABLE PROMISCUOUS MODE

enable the promiscuous mode and forged transmits in order to run your CVM IP:

Select the server as shown in the figure below and go to the configuration tab and click on the networking as shown below and then click on the properties tab as shown in the figure below.

File Edit View Inventory Ad	dministration Plug-ins Help					
🎦 🖾 🏠 Home 🕨 🍜	Inventory 🕨 🛅 Inventory					
921.660.94 testi	Cocalitoss I localiformann VYSwor Cocalitoss I localiformann VYSwor Cocalitoss Canted Summary V Health Status Processors Memory Storage Networking Prover Management Software Licensed Reatures This Configuration DNS and Reatures The Configuration DNS and Reatures Vistual Machine Storius/SW Vistual Machine Storius/SW Vistual Machine Storius/SW	e (SX), 6.0.0, 3620759 Evalu httual Machines Resource Alloc View: SSphere Networking Standard Switch: Vinal 14500 Vinal 14500 Vinke 1920 Vinke 1920 Vin	Ation (60 days remaining) ation. Performance. Configuration (1) Standard Switch Yewitcho Remov Performance Prysol Alapara Prival Alapara Chine(s) Yewitch Alapara Chine(s) Yewitch Alapara Chine(s) Yewitch Alapara Solo Solo H	rers Events Permissions	Refresh Add Networkin	g Properties
Recent Tasks					Name, Target or Status contains: -	Clear ×
Name Ta	arget Status	Details Initiated by	Requested Start Ti 🤝 Start Time	Completed Time		
Tasks					Evaluation Mode: 60 da	ys remaining root

> Select the vSwitch or any of the below options and click on edit settings

Note: Lets understand what promiscuous mode: In the realm of computer networking, promiscuous mode refers to the special mode of Ethernet hardware, in particular network interface cards (NICs), that allows a NIC to receive all traffic on the network, even if it is not addressed to this NIC. If "promiscuous mode" on the vSwitch or VM network where Nutanix-ce VM is connected is NOT enabled the Controller VM (CVM) is not accessible.

INetwork Adapters		Colores Chardend Collector Descention	-	
Configuration	Summary	VSphere Standard Switch Properties	5	
vSwitch	120 Ports	Number of Ports:	120	
Management Net	Virtual Machine vMotion and IP	Advanced Properties	1500	
		Default Policies		
		Security		
		Promiscuous Mode:	Accept	
		MAC Address Changes:	Accept	
		Forged Transmits:	Accept	
		Traffic Shaping		
		Average Bandwidth:		
		Peak Bandwidth:		
		Burst Size:		
		Failover and Load Balancing		
		Load Balancing:	Port ID	
		Network Failure Detection:	Link status only	
		Notify Switches:	Yes	
		Failback:	Yes	
Add	Edit Remove	Active Adapters:	vmnic0	

- Go the security tab and check the promiscuous mode as accept and forged transmits as accept as show in the figure below.
- > You may also need to enable "forged transmits"

General Security Traffic Shaping NIC Teaming Policy Exceptions Promiscuous Mode: Accept Accept Forged Transmits: Accept Accept			ties	vSwitch0 Prop
Policy Exceptions Promiscuous Mode: MAC Address Changes: Forged Transmits: Accept		NIC Teaming	Traffic Shaping	eneral Securit
Promiscuous Mode: MAC Address Changes: Forged Transmits: Accept Accept 			s	Policy Excepti
MAC Address Changes: Accept Forged Transmits: Accept	-	Accept	ode:	Promiscuous
Forged Transmits:		Accept	Changes:	MAC Addres
		Accept	uits:	Eorged Tran
		Inccept		

STEP 5 UPLOAD VMDK

Upload ce-flat.vmdk and cd.vmdk into datastore.

> Right click on the datastore and select browse datastore.



File Edit View Inventory Administration Plug-ins Help	
🔝 🔝 🛕 Home 🕨 👸 Inventory 🕨 🎁 Inventory	
at et	
i 192.168.0.127 localhost.Jocaldomain VMware ESXi, 6.0.0, 3620759 Evaluation (60 days remaining)	
Getting Started: Summary Virtual Machines Resource Allocation, Performance, Configuration, Users, Events, Permissions	
Con (2) Datatore Browser - [datastore2] X	^
SS Folders [datastore2] /	
Gen 🕞 📂 / Name Size Type Path Modif	
Mar 🗗 .sdd.sf 📁 .sdd.af Folder [datastore2].sdd.af	
Mod	
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eog Hys	
Nor I I I I I I I I I I I I I I I I I I I	
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vSphere HA State @ N/A	
Head Confer and for ET M/A Refresh Virtual Machine Counts	~
Recent Tasks Name, Target or Status contains: Clex	, ,
Name Target Status Details Initiated by Requested Start Time Completed Time	
Task Evaluation Mode: 60 days remaining	root

> Click on the upload button on the top as shown in the picture and select both files and upload.

STEP 6 PREPARE TO CREATE VM

Login to the VMware ESXi 6.0 using putty

Browse to /vmfs/volumes/datastore2 and change the ce-flat.vmdk.img to ce-flat.vmdk and ce.vmdk.txt to ce.vmdk using below commands

- mv ce-flat.vmdk.img ce-flat.vmdk
- mv ce.vmdk.txt ce.vmdk



STEP 7 CREATE VM

Right click on the server and create a new virtual machine.

🙆 192 168 0 127 - vSi	nhr	re Client				– a ×
File Edit View In	ver	tory Adminis	tration Plug-ins Help			
	lom	e 🌶 🛲 Inve	ntory b 🕅 Inventory			
<u> </u>	_					
192.168.0.	t	New Virtual M	achine Ctrl+N	are ESXi, 6.0.0, 3620759 Evalu	ition (60 days remaining)	
6	5	New Resource	Pool Ctrl+O	Virtual Machines Resource Alloca	tion Performance Configuration Users Events Permissions	
		Enter Mainten	ance Mode			
		Rescan for Dat	astores	een enabled		
		Add Permissio	n Ctrl+P	nabled		
		Shut Down			Resources	
		Reboot		Dell Inc.	CPU usage: 47 MHz Capacity	
		Report Summa	ary	PowerEdge R610	8 x 2.526 GHZ	
		Report Perform	nance	Intel(R) Xeon(R) CPU	Memory usage: 1945.00 PB Capacity 32755.02 MB	
		Open in New \	Window Ctrl+Alt+N	E5540 @ 2.53GHz	Detre Date Constitu	
			Processor Sockets: Cores per Sockets: Logical Processors: Hyper threading: Number of NLOs: State: Virtual Machines and Templa VMotion Enabled: VMware EVC Mode: VSphere HA State Likest Confessed for ET:	2 4 16 Active 4 Connected tes: 0 N/A Disabled @ N/A	detectore: Non-SSU 5J/W US SJ(detectore:	
Recent Tasks						Name, Target or Status contains: • Clear ×
Name		Target	Status	Details Initiated by	Requested Start Ti 🖙 Start Time Completed Time	
Tasks	_					Evaluation Mode: 60 days remaining root
Ask n	ne	anything		4 🗆 🤤 🧿	🚍 🖨 🔽 🧕 🖉 😁 🕮	<u>운</u> 속 饱 및 예 12/28/2016 🗟

Select typical configuration and click next

🚱 192.168.0.127 - vSphere Client			- 0 ×
Eile Edit View Inventory Administration Plug-ins	🕝 Create New Virtual Machine	- 🗆 ×	
🔄 💽 🏠 Home 🕨 🚮 Inventory 🕨 🗊 Invento	Configuration	Virtual Machine Version:	11
र्स अ	Select the configuration for the virtual m	nachine	
1 192 168 0 127			
Getting Started Su Configuration Iss ESX shel for the hosths SH for the hosths General Manufacturer: Model: CPU Cores: Processor Type: License: Processor Sockets: Cores per Socket: Logial Processors:	Configuration Name and Location Storage Quest Operating System Network Create a Disk Ready to Complete	ation pical ate a new virtual machine with the most common devices and configuration options. stom ate a virtual machine with additional devices or specific configuration options.	
Number of NLCs: State: Virtual Machines and Virbion Enabled: VMware EVC Mode: VSphere HA State Host Confinueat for			v
News Charles Charles			
Target Status			-
		≤ Back Next ≥ Cancel	
Tasks			Evaluation Mode: 60 days remaining root

> Give name for the virtual machine and click next

🚱 192.168.0.127 - vSphere Client			_
Eile Edit View Inventory Administration Plug-ins He	🕝 Create New Virtual Machin	·	
🔄 💽 🏠 Home 🕨 🏭 Inventory 🕨 🗊 Invento	Name and Location	Virtual Machine Version	11
र्स ह	Specify a name and locatio	n for this virtual machine	
192 168 0 127			
localitost.localdoma	Configuration	Name:	
Getting started Sur	Name and Location Storage	test 1	-
Configuration Iss	Guest Operating System	Virtual machine (VM) names may contain up to 80 characters and they must be unique within each vCenter Server VM folder.	
ESX Shell for the ho SSH for the host ha	Network Create a Disk	VM folders are not viewable when connected directly to a host. To view VM folders and specify a location	
Conoral	Ready to Complete	for this VM, connect to the vCenter Server.	
General			
Manufacturer: Model:			
CPU Cores:			
Processor Type:			
License:			
Processor Sockets:			
Cores per Socket:			
Logical Processors:			
Number of NICs:			
State:			
Virtual Machines and			
VMware EVC Mode:			
vSohere HA State			
Host Configured for			×
Recent Tasks			Target or Status contains: Clear
Name Target Status			
		_≤Back Next ≥ Cancel	
Tasks			Evaluation Mode: 60 days remaining root

> Click on the datastore1 and click next, here in the below image Non-SSD is nothing but your HDD.

🕝 Create New Virtual Machine	•						_	- ×
Storage Select a destination storage	for the	e virtual machine fil	es			Vi	rtual Machi	ine Version: 11
Configuration	Select	a destination stora	ge for the virtu	al machine files:				
Name and Location Storage Guest Operating System Network Create a Disk Ready to Complete	Nam	e	Drive Type	Capacity	Provisioned	Free	Туре	Thin Prov
		datastore1	SSD	549.75 GB	974.00 MB	548.80 GB	VMFS5	Supporte
		datastore2	Non-SSD	923.50 GB	976.00 MB	922.55 GB	VMFS5	Supporte
	<							>
	Disable Storage DRS for this virtual machine Select a datastore:							
	Nam	e	Drive Type	Capacity P	rovisioned	Free	Туре	Thin Provi
	<							>
					< Back	Next	>	Cancel

> Select guest operating system as linux and click next

🕝 Create New Virtual Machin	e	_		\times
Guest Operating System Specify the guest operating	g system to use with this virtual machine	Virtual M	lachine Ver	sion: 11
Configuration Name and Location Storage Guest Operating System Network Create a Disk Ready to Complete	Guest Operating System:	appropriate	defaults fo	١r
	< Back	Next >	Can	cel

> Change the adapter to E1000 and click next

🕝 Create New Virtual Machine			_		\times
Network Which network connections will be us	ed by the virtual machine?		Virtual M	achine Versi	on: 11
Configuration Name and Location Storage Guest Operating System Network Create a Disk Ready to Complete NIC	a Network Connections many NICs do you want to connect? Network I: VM Network If supported by this virtual machine version, mor virtual machine is created, via its Edit Settings di pter choice can affect both networking performation ported for various guest operating systems and	Adapter Adapter E1000 e than 4 NICs can be a alog. ance and migration cor on choosing among the hosts.	✓ dded after mpatibility a network	Connect at Power On The the c. Consult adapters	
<u> </u>		< Back Ne	ext >	Cance	el 🔤

> Give virtual disk size as 16gb and select thin provision and click next.

🕜 Create New Virtual Machin	e			_		×
Create a Disk Specify the virtual disk size	and provisioning policy			Virtual Ma	chine Ver	sion: 11
Configuration Name and Location	Datastore:	datastore 1				
Storage Guest Operating System	Available space (GB):	536.0				
<u>Network</u> Create a Disk	Virtual disk size:	16 🕂 GB 🔻				
Ready to Complete	C Thick Provision Lazy Zeroe	d				
	C. Thick Provision Eager Zero	ed				
	Thin Provision					
			< Back	Next >		Cancel

Create New Virtual Machin Create a Disk Specify the virtual disk size	ne e and provisioning policy				Lachine Ver	X sion: 11
Configuration Name and Location Storage Guest Operating System Network Create a Disk Ready to Complete	Datastore: Available space (GB): Virtual disk size: C Thick Provision Lazy Z C Thick Provision Eager Thin Provision	datastore 1 536.0 16 ÷ GB v Zeroed Zeroed				
			< Back	Next >	Can	cel

> Check the option edit virtual machine settings before completion and click next

🕝 Create New Virtual Machin	e		_		\times
Ready to Complete Click Finish to start a task t	hat will create the new virtual mad	hine	Virtual M	achine Ver	sion: 11
Configuration Name and Location Storage Guest Operating System Network Create a Disk Ready to Complete	Settings for the new virtual mac Name: Host/Cluster: Datastore: Guest OS: NICs: NIC 1 Network: NIC 1 Type: Disk provisioning: Virtual Disk Size: ✓ Edit the virtual machine sett	hine: test1 localhost. datastore1 Red Hat Enterprise Linux 7 (64-bit) 1 VM Network E1000 Thin Provision 16 GB tings before completion hine (VM) does not include automatic installation of on the VM after creating the VM.	of the gue	st operatir	ng I
			Turice	Can	

> Remove floppy drive, cd/dvd, new hard disk and next click on and select hard disk and click next.



Device Type

What sort of device do you wish to add to your virtual machine?

Device Type Ready to Complete	Choose the type of device you wish to add.
	 Serial Port Parallel Port Floppy Drive CD/DVD Drive USB Controller USB Device (unavailable) PCI Device (unavailable) Ethernet Adapter Hard Disk SCSI Device
	< Back Next > Cancel

Select the use an existing virtual disk and click next.

🛃 Add Hardware		\times
Select a Disk		
Device Type Select a Disk	A virtual disk is composed of one or more files on the host file system. Together these files appear as a single hard disk to the guest operating system.	
Advanced Options	Select the type of disk to use.	
Ready to Complete	 Disk Create a new virtual disk Use an existing virtual disk Reuse a previously configured virtual disk. Raw Device Mappings Give your virtual machine direct access to SAN. This option allows you to use existing SAN commands to manage the storage and continue to access it using a datastore. 	
	< Back Next > Can	cel

Select the datastore where you have stored the ce.vmdk file and select the ce.vmdk and click ok.

 \times

🕝 Browse Datastore	*S	—		\times
Look in: Datastor	es	- t		
Name	Capacity	Free space		
datastore2	923.50 GB	922.55 GB		
datastore1	549.75 GB	548.80 GB		
File type:	Compatible Virtual Dis	ks (*.vmdk, *.dsk, *. 💌	Open Cancel	

🕝 Browse Datastores			—		\times
Look in: datastore2		-			
Name	File Size	LastModifi	ed		
📁 .sdd.sf					
📇 ce.vmdk	7 GB	12/28/2016	5:45:20	AM	
,					
				ОК	
File type:	mpatible Virtual Disks (*	.vmdk. *.dsk. *.	ㅋ 🗀	Cancel	_
100		itinant, itabit, i		Cancer	

Leave the options to c	lefault and click next	
🕝 Add Hardware		\times
Advanced Options These advanced options d	o not usually need to be changed.	
Device Type Select a Disk Select Existing Disk Advanced Options Ready to Complete	Specify the advanced options for this virtual disk. These options do not normally need to be changed. Virtual Device Node SCSI (0:0) Mode Independent Independent disks are not affected by snapshots. Persistent Changes are immediately and permanently written to the disk. Nonpersistent Changes to this disk are discarded when you power off or revert to the snapshot.	
	< Back Next > Cano	:el

> Click finish.

🕝 Add Hardware		\times
Advanced Options These advanced options do	o not usually need to be changed.	
Device Type Select a Disk Select Existing Disk Advanced Options Ready to Complete	Specify the advanced options for this virtual disk. These options do not normally need to be changed. Virtual Device Node SCSI (0:0) Mode Independent Independent disks are not affected by snapshots. Persistent Changes are immediately and permanently written to the disk. Changes to this disk are discarded when you power off or revert to the snapshot.	
	< Back Next > Cance	=

> Click on the add and select hard disk and click next and select an option to create a new virtual disk.

🗿 Add Hardware		\times
Select a Disk		
Device Type Select a Disk Create a Disk Advanced Options Ready to Complete	A virtual disk is composed of one or more files on the host file system. Together these files appear as a single hard disk to the guest operating system. Select the type of disk to use. Disk © Create a new virtual disk © Use an existing virtual disk Reuse a previously configured virtual disk. © Raw Device Mappings Give your virtual machine direct access to SAN. This option allows you to	
	use existing SAN commands to manage the storage and continue to access it using a datastore. < Back	

Specify the disk size as 500GB and select thin provision and select "Specify a datastore or datastore cluster" and click browse.

🕝 Add Hardware		\times
Create a Disk Specify the virtual disk size	e and provisioning policy	
Device Type Select a Disk Create a Disk Advanced Options Ready to Complete	Capacity Disk Size: 500 GB Disk Provisioning C Thick Provision Lazy Zeroed C Thick Provision Eager Zeroed (C Thin Provision	
	Location C Store with the virtual machine Specify a datastore or datastore duster: Browse	
	< Back Next > Can	cel

> Select a non-ssd datastore for the 500GB virtual disk and click ok.

🕝 Select a datastore of	r datastore clu	ster				—		\times
Select a datastore or dat	astore cluster:							
Name	Drive Type	Capacity	y Provisioned	Free	Туре	Thin Provision	oning	
datastore2	Non-SSD	923.50 G	B 976.00 MB	922.55 GB	VMFS5	Supported		
datastore1	SSD	549.75 G	B 974.00 MB	548.80 GB	VMFS5	Supported		
Disable Storage DRS	S for this virtual	machine						
Select a datastore:								
Name	Drive Type	Capacity	Provisioned	Free	Туре	Thin Provision	ning	
1								
						ОК	Cano	el 🛛

- > Follow the same steps and create another virtual disk using following option
 - Disk size : 200GB

- Disk provisioning: thin provision
- Location: specify a datastore or a datastore cluster

And select ssd as a datastore for the 200GB virtual disk and click ok and finish.

Select a datastore or	datastore clust	er				_		\times
Select a datastore or data	astore duster:							
Name	Drive Type	Capacity	Provisioned	Free	Туре	Thin Provisi	oning	
datastore2	Non-SSD	923.50 GB	976.00 MB	922.55 GB	VMFS5	Supported		
datastore1	SSD	549.75 GB	974.00 MB	548.80 GB	VMFS5	Supported		
1								
Disable Storage DRS	6 for this virtual m	nachine						
Select a datastore:								
Name	Drive Type	Capacity Pr	ovisioned	Free	Туре	Thin Provision	ning	
							Com	
						UK	Canc	ei

> Increase the memory to 16GB as show in the figure below.

🕜 t	est1 - Virtual Machine Propertie	s					\times
Hard	ware Options Resources			Virt	ual Machine	Version:	11 🗥
	Show All Devices	Add Remove		Memory Size:	16 🛟	GB 👻	
Hare	dware	Summary	2 ТВ -	Maximum recomm	anded for t	bic	
200	Memory	16384 MB	1 ТВ	guest OS: 4080 0	SB.	riis	
	CPUs	1 Midaa and	512 GB	Maximum recomm	nended for b	est	
	VICE device	Deprecated	256 68	 performance: 32 	756 MB.		
	SCSI controller 0	Paravirtual	129 CP	Default recomme	nded for this	s	
	Hard disk 1	Virtual Disk		Minimum cocomm	and ad far th	i.e	
	Hard disk 2	Virtual Disk	64 GBH	guest OS: 512 Million	B.	115	
	Hard disk3	Virtual Disk	32 GB				
	Network adapter 1	VM Network	16 GB				
			8 GB -				
			4 GB				
			2 GB				
			1 GB				
			E12 MP				
			256 MB				
			128 MB				
			64 MB				
			32 MB				
			16 MB				
			в мв 🗕				
			4 MB				
1							
				0	к	Cancel	

Set the number of cores per socket to 4 as shown in the figure below and also select the SCSI controller 0 and click on change type to change its default type to paravirtual type.

🕝 test1 - Virtual Machine Propertie	*S		—		\times
Hardware Options Resources			Virtual Machin	ne Version:	11 🗥
Show All Devices	Add Remove	Number of virtual sockets:	1	-	
Hardware	Summary	Number of cores per socket:	4	-	
Memory	16384 MB				
🔲 CPUs (edited)	4	Total number of cores:	4		
Video Card VMCI device SCSI controller 0 Hard disk 1 Hard disk 2 Hard disk 3 Network adapter 1	Video Cara Deprecated Paravirtual Virtual Disk Virtual Disk Virtual Disk VM Network	Changing the number of virt OS is installed might make yourstable. The virtual CPU configuration might violate the license of t	wal CPUs after our virtual mad n specified on the guest OS.	the guest hine this page	
			ОК	Cancel	

STEP 8: POWER ON THE VM AND INSTALL NUTANIX CE

Now the virtual machine is ready and go ahead and power on the virtual machine and launch the console window in vsphere. Then you will see the below screen.



> Login as a root user and the password as nutanix/4u

> Browse to the cd /home/install/phx_iso/phoenix as the below image.



- Now that you have accessed the directory now all you need to do some changes within the directory for your Nutanix CE to install successfully without any error to do that first type in the command /home/install/phx_iso/phoenix/minimum_reqs.py this will allow you to enter inside the code and do some hardcode editing to fit in our current requirement.
- Ones you have entered inside the code drag down the panel and down you will find the below line of code which you need to comment by using # symbol in front it as shown in the image below.

	<pre>try: # If the node has a bad disk the dmesg buffer can get flooded with sense # errors. Before disk interaction livecd.sh will save the output in a # temporary file which will be available to read from during the UT-d check. with open("/tmp/dmesg_out") as dm: dmesg = dm.read() except IOError: ret, dmesg, err = sysUtil.shell_cmd(["dmesg"])</pre>
#	checkMemory(meminfo) checkCores(cpuinfo) checkVtx(cpuinfo) checkIsIntel(cpuinfo)
	<pre>if os.environ.has_key('COMMUNITY_EDITION'): boot_disk = sysUtil.find_boot_disk(param_list) if not boot_disk: raise StandardError('Unable to detect boot device from /proc/mounts.') if not param_list or param_list.svm_install_type == 'clean': CE checkDisks(boot dev=boot disk.dev)</pre>
	else: checkVtd(dmesg) checkSSD() checkDiskModels(param_list) checkInstallationDiskSize(param_list)

- Remember the minimum SSD requirement for installing Nutanix is greater than or equal to 200, so the Nutanix CE installation process will throw error if you do not have minimum 200gb SSD.
- You need to lower the IOPS thresholds (SSD_rdIOPS_thresh and SSD_wrIOPS_thresh from 5000 to 1000 as shown below) to do that type in the below command /home/install/phx_iso/phoenix/sysUtil.py.
- Set the SSD_rdIOPS_thresh = 1000
- Set the SSD_wrIOPS_thresh = 1000

# Contains custom SUM resource settings per model. Defaults will be used # if a particular model does not exist in this structure.	
SUM GB $RAM = 16$	
SVM NUM VCPUS = 8	
svm_resource_map = {	
'NX-1020': { 'vcpus': 4, 'ram': 12 },	
'NX-1050': { 'vcpus': 8, 'ram': SVM_GB_RAM }	F,
$^{\prime}NX-4170': \{ ^{\prime}vcpus': 16, ^{\prime}ram': 64 \},$	
'NX-8150': { 'vcpus': SUM_NUM_UCPUS, 'ram': 32 },	
'NX-9040': { 'vcpus': SUM NUM UCPUS, 'ram': 32 },	
}	
RE_WWN_SEARCH = re.compile(r"(^Logical Unit id: +0×(\w+)\$) "	
"(^LU WWN Device Id: +(\w.+?)\$)", re.MULTILINE)	
RE_SERIAL_SEARCH = re.compile(r"(^Serial [nN]umber: $+(Nw+)$)", re.MULTILINE)	
RE_MODEL_SEARCH = re.compile(r"(^Device Model: +(\w+)\$)", re.MULTILINE)	
RE_FIRMWARE_SEARCH = re.compile(r"(^Revision: +(\w+)\$)", re.MULTILINE)	
perf_cache = {}	
SSD_rdIOPS_thresh = 1000	
SSD_wrIOPS_thresh = 1000	
def shell_cmd(cmd, wait=True, fatal=True, ttyout=False):	
This function will execute a command on a snawned	
shell process and will check return status if set	
and will dumm output to screen (ttuout) if set.	

> Exit from the root user and login as an install user to start installation process



Leave it to default and use tab to proceed to next step.

Please	elect your	keuboard	lauout fr	om the fo	llouing lie	+		
I lease	select your	Keybbaru	Tayout II		riowing iis			
******	**************************************	yboard La	ayout ×××××	******	****			
i ua-u	ci -ws							
l uk	2							
l unic	ode				i			
* us *					1			
us-a	centos				1			
us-a	lt-intl							
i US-a	1 tyr-11t1	*******		*******	-			
Cancel	Proceed							
Lancel	Proceed							
Cancel	Proceed							

> Leave it to default and use tab to proceed to next step.

<< Nutanix Community Edition Installer >>
WARNING: Destructive IO tests will be run on the following disks in order to confirm acceptable performance. If the disks listed below still have any data on them, please cancel and backup your data first.
i sdb: Model [Uirtual disk], Size 1536.87] GB, Serial [None] i
i sdc: Model [Uirtual disk], Size [161.86] GB, Serial [None] i
Canada Propagad
Caller i Foleea

> Please wait for 10-30 minutes to install Nutanix



> Enter the ip address and subnet mask and check "create single node cluster" and proceed to next step.

 Nutanix OS (NOS) version 2015.11.05-STABLE will be installed. MTE: Leaving the IP information below blank will trigger the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of DHCP, which is not recommended unless the IP information below blank will trigger and the use of the U	<< Mutanix Community Edition Installer >>
<pre>MTE: Leaving the IP information below blank will trigger the use of DHCP, which is not recommended unless the IP and the server assigned statically in your DHCP server.</pre>	Mutanix OS (NOS) version 2015.11.05-STABLE will be installed.
Host fir Address iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	NOTE: Leaving the IP information below blank will trigger the use of DHCP, which is not recommended unless the IP addresses are assigned statically in your DHCP server.
CUT IF Address	Host IP Address : Host Subnet Mask : Host Gateway :
Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8.8 Image: Provide a single node cluster? DNS Server (req'd): 8.8.8.8.8 Image: Provide a single node cluster single node cluste	CUM IP Address : CUM Subnet Mask : CUM Gateway :
COMPLENITY EDITION END USER LICENSE AGREEMENT IMPORTANT - READ CAREFULLY READ THIS COMMUNITY EDITION END USER LICENSE AGREEMENT (THE "AGREEMENT") BEFORE DOLMLOADING, INSTALLING, COPYING, (COMFIGURING, ACCESSING, DEPLOYING AND OR USING THE SOFTWARE. BY DOLMLOADING, INSTALLING, COPYING, (CONFIGURING, ACCESSING, DEPLOYING AND OR OTHERWISE USING ALL OR ANY PART OF THE SOFTWARE OR BY CLICKING ON AM "ACCEPT" BUTTON, YOU AGREE TO THE TERMS AND CONDITIONS OF THIS AGREEMENT. YOU FURTHER AGREE THAT YOU ARE BOUND BY (AND ARE A PARTY TO THIS AGREEMENT, AND, IF YOU ARE ACCEPTING THESE TERMS ON BEHALF OF ANOTHER PERSON OR A (COMPANY OR OTHER LEGAL ENTITY, YOU REPRESENT AND WARRANT THAT YOU HAVE FULL AUTOMOTIVE TO BIND THAT PERSON, COMPANY, Cancel Start	[X] Create single-node cluster? DNS Server (req'd): 8.8.8.8
	COMPLIAITY EDITION END USER LICENSE AGREEMENT IMPORTANT - READ CAREFULLY READ THIS COMPLIAITY EDITION END USER LICENSE AGREEMENT ICTHE "AGREEMENT") BEFORE DOWNLOADING, INSTALLING, COPYING, ICONFIGURING, ACCESSING, DEPLOYING AND/OR USING THE ISOFTWARE. BY DOWNLOADING, INSTALLING, COPYING, ICONFIGURING, ACCESSING, DEPLOYING AND/OR OTHERWISE USING IALL OR AMY PART OF THE SOFTWARE OR BY CLICKING ON AN "ACCEPT" BUTTON, YOU AGREE TO THE TERMS AND CONDITIONS OF ITHIS AGREEMENT. YOU FURTHER AGREE THAT YOU ARE BOUND BY IAND ARE A PARTY TO THIS AGREEMENT, AND, IF YOU ARE IACCEPTING THESE TERMS ON BEHALF OF ANOTHER PERSON OR A I COMPANY OR OTHER LEGAL ENTITY, YOU REPRESENT AND WARRANT ITHAT YOU HAVE FULL AUTHORITY TO BIND THAT PERSON, COMPANY, THAT YOU HAVE FULL AUTHORITY TO BIND THAT PERSON, COMPANY, ISOFTWARE YOU THER LEGAL ENTITY TO BUIND THAT PERSON, COMPANY, ISOFTWARE TO THE AGREE INCOME AGREENT AND WARRANT I ACCEPT THE ENDING THER AGREE INTO THE THERE AGREENT AND WARRANT I ADD ARE A STAT

> After successful installation of Nutanix you will see the screen below and press enter to continue

Configuring a Nutanix CE cluster

Although it is possible to configure a cluster form the main cluster_init page:

http://CVM-IP-ADDRESS:2100/cluster_init.html

Some operations cannot be completed through this cluster_init interface, or from the Create single-node cluster option during the install, namely creating a cluster where the host IP Address and CVM IP Address are on the same subnet (such as 192.168.x.x):

Although we will use the command-line method to configure the cluster in this guide, an example of the cluster_init interface is shown below:

Cluster Name: NTX-T5500		
Cluster External IP: 192.168.0.110		
Cluster Max Redundancy Factor: 2		
CVM DNS Servers: 192.168.0.1		
CVM NTP Servers: pool.ntp.org		
Hypervisor DNS Servers: 192.168.0.1		
Hypervisor NTP Servers: 3. centos. pool. ntp. o	org,O. centos. pool. ntp. org,2. centos. po	ol.ntp.org,
Cluster-wide Network settings:		
Controllar	Hundryikor	TOMT
Subnet Mask 255.255.0	255.255.255.0	1-1-1
Default Gateway 192.168.0.254	192.168.0.254	
Discovered nodes:		
Select Node Controller IP	Hypervisor IP	IPMI IP
Ic864377/A 192.168.0.111	192.168.0.11	
	402 409 0 42	
4e4834a6/A 192.168.0.112	192.166.0.12	

INSTALL AN SSH CLIENT:

To access the CVM host over SSH you will need an SSH client:

- SSH Under Linux
- SSH Under MacOS
- Putty Windows

SSH under Linux

ssh CVM-IP-ADDRESS (Where CVM-IP-ADDRESS is the IP Address of the CVM)

Single-node and Multi-node clusters

Due to the way Nutanix CE protects and distributes data across hosts, only the following cluster sizes are available:

- Single-node cluster 1 Host no data redundancy
- Multi-node cluster 2 hosts not available
- Multi-node cluster 3 hosts with data redundancy
- Multi-node cluster 4 hosts with data redundancy

CREATE A SINGLE-NODE CLUSTER

To create a single-node cluster, SSH into the host and provide the following user information: User: nutanix Password: nutanix/4u

Then run the following commands:

cluster -s CVM-IP -f create

ncli cluster add-to-name-servers servers="DNS-SERVER"

ncli cluster get-name-servers (Where CVM-IP is the IP Address of the CVM, and DNS-SERVER is a single IP Address or comma separated list of IP Addresses of DNS Servers)

NOTE: If DNS servers are not configured correctly at this stage registering the installation against your NEXT account in the next section will fail.

CREATE A MULTI-NODE CLUSTER

To create a multi-node cluster, SSH into the host and provide the following user information:

User: nutanix Password: nutanix/4u

Then run the following commands:

cluster -s CVM-IP -f create

ncli cluster add-to-name-servers servers="DNS-SERVER"

ncli cluster get-name-servers (Where CVM-IP is comma separated list of IP Addresses of the CVM's on each of the host you wish to include in the cluster, and DNS-SERVER is a single IP Address or comma separated list of IP Addresses of DNS Servers)

NOTE: If DNS servers are not configured correctly at this stage registering the installation against your NEXT account in the next section will fail.

	☐ Home ×] 192.168.0.94 × ☐ test1 ×	
	INFO: Copying SSH keys INFO: Installing firsthoot marker file	^
	INFO: Imaging thread 'hypervisor' has completed successfully	
	[665.920009] sdc1: URITE SAME failed. Manually zeroing.	
	INFU: Creating lagout file for communityLation in position H INFO: In jecting nost-cluster create settings into CUM	
	INFO: Copying diagnostic VM into SVM	
	INPO: Imaging of SMI has completed successfully!	
	INFU: Imaging thread som has completed successfully INFO: Cleaning up	
	INFO: Imaging process completed successfully!	
	Undating the initramfs done.	
	Waiting for the Mutanix Controller Whito start upl. 740.39534011KWm [9812]: vcpu8 unhandled wrmsr: 8x38d data 8 [746.992829] kwm [9812]: vcmu1 muhandled wrmsr: 8x38d data 8	
	[707.822063] kvm [9812]: vojud unhandled wrmsr: 0x38d data 0	
	[787.823652] kwn [9812]: vcpu1 unhandled wrmsr: 0x38d data 0	
	[787.113774] KWM [3612]; VEPU8 UNNANATE PAMER; 8X384 [787.117984] KWM [3612]; VEPU8 UNNANTE PAMER; 8X384	
	.[711.464133] kvm [9812]: vcpu0 unhandled rdmsr: 0x30d	
	.[718.662716] kom [9812]: vopu0 unhandled rdmsr: 0x38d	
	[718.703401 kwn [9812]: vcpu0 unnantet runs: 0x100	
	[718.704655] kvm [9812]: vcpu0 unhandled rdmsr: 0x1a6	
	[718.7059761] kum [9812]: vopu0 unhandled rdmsr: 0×376 [718.757261] kum [9812]: vopu0 unhandled rdmsr: 0×376	
	[718.0579579] kwn [5012]: vepul unhandled runsi: 0x30d	
	Success! Press (Enter) to return the login prompt.	
	Please refer to the documentation for next steps.	
	show the IP address of the COM.	
	In case of a repair, the CVM will take a couple more	
	minutes to come up.	
1	or press Citle G	
1	a basan a	

Use CVM IP to login to the prism



> Open the web browser and enter the CVM IP and prism will load and use admin as username and admin as password.

← → C ▲ 🗚 🖓 🗛 🕹 ↔ 🖓 ↔ 🖓 ↔ 🖓 ↔ 🖓 ↔ 🖓 ↔ 🖓 ↔ 🖓 ↔	☆	0	:
PRISM			
		Inuumi	
f 🖸 Ask me anything 🛛 🕒 🤮 🌀 🗮 🋱 🥊 💁 🛃 💋 📴 🖉 😁 🎦 🔨 🗠 🕾 💭 🖉	6:30 PM 12/28/201	6 F	

	192.168.0.92:9440/console/	#						☆ 0 :		
<u>Unnamed</u> Ho	me v∣çovr⊥j	L · O •	•	N _{co}			Q ? ~	🗘 - 🛛 Admin 🚨 -		
Hypervisor Summary		Cluster-wide Controller IOPS .		Health			Critical Alerts			
AHV HYPERVISOR	Nutanix 20150513 Version	100 IOPS 4:00 PM 5:00 F	PM 6:00 PM		GOOD					
Storage Summary		Cluster-wide Controller IO B/W		Disks 0 0 0 2						
452.28 GIB	 ⑦ Used 0 GiB ⑦ Capacity 452.28 GiB 	IOU INDES		VMs	• • •	0 01	N	lo Alerts		
VM Summary		4:00 PM 5:00 PM 6:00 PM Cluster-wide Controller Latency -			Data Resiliency Status			Warning Alerts		
1 VM(5)	Avail Best Effort © On 1 © Off 0 © Suspend 0 Paused 0	1 ms 4:00 PM 5:00 F	PM 6:00 PM				N	lo Alerts		
Hardware Summary		Cluster CPU Usage	Cluster Memory Usage	N/A Data Resiliency status not available		ilable	Info Alerts	Events		
11 нозт вlock	CommunityEdition MODEL	14.4 % OF 10.11 GHz	83.86 % OF 15.51 GIB				No Alerts	10 EVENT Last event 5 minutes ago		
O Ask me anyth	ing	l (D) 🤤	o 🛢 🖨 🗖	S 🗐	😁 🕮 🗖	v 🔁 🛛		定 (13) 📼 6:33 PM 12/28/2016 🕤		

Starting and stopping services

STARTING

The correct Start order is HOST > CVM > VMs To check the status of a Nutanix CE cluster, login to a CVM as user: nuatnix, password: nutanix/4u and type the following: cluster status To start a Nutanix CE cluster, login to a CVM as user: nuatnix, password:nutanix/4u and type the following: cluster start To start a Nutanix CE VM, go to the VM Table under the VM menu in PRISM and select a Power option from the list.

STOPPING

The correct Stop order is VMs > CVM > Host

To stop a Nutanix CE VM, go to the VM Table under the VM menu in PRISM and

select a Power option from the list.

To check the status of a Nutanix CE cluster, login to a CVM as user: nuatnix,

password: nutanix/4u and type the following:

cluster status

To stop a Nutanix CE cluster, login to a CVM as

user: nuatnix,

password: nutanix/4u

and type the following:

cluster stop

To stop a Nutanix CE CVM, login to a CVM as

user: nuatnix,

password:nutanix/4u

and type the following:

sudo shutdown –h now

To stop a Nutanix CE Host, login to a CVM as user: root, password: nutanix/4u

and type the following:

shutdown -h now

POWERING OFF A WHOLE CLUSTER

Complete shutdown

The correct Shutdown order for a whole Nutanix CE cluster is as follows:

- Shutdown and power off each individual VM through PRISM
- > Log into any CVM as "nutanix" and issue a "cluster stop", followed by a

"cluster status" (just to check that everything did shutdown cleanly)

> Log into each CVM individually as "nutanix" and issue a "sudo shutdown

-h now"

Log into each Host individually as "root" and issue a "sudo shutdown -h

now"

NOTE: Each Host has its own IP Address, plus an additional IP Address for the

CVM that runs on each node.

NOTE: If the commands do not work as expected be sure to check that you are

logging onto the correct IP Address and as the correct user (root for the physical

host and nutanix for the CVM virtual machine).