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A Biography of the authors of the book

A preview chapter from the book, Chapter NO.6 "Service Offerings and Virtual Machines"

A synopsis of the book’s content

Information on where to buy this book

About the Authors

Navin Sabharwal is an innovator, as well as a leader, author, and consultant in areas of Cloud Computing, Cloud Lifecycle Management, and Software Product Development.

He has been involved in identifying white spaces in areas of Information Technology and creating innovative products and services. He has taken ideas from their inception to revenue generation.

He has taken some of his ideas to develop innovative award winning products and solutions in the areas of Cloud Lifecycle Management, IT infrastructure management, IT processes, reporting analytics, and governance.

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For More Information:
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Ravi Shankar holds a postgraduate degree in Information Technology from the Indian Institute of Information Technology and Management, Gwalior, India. He has been working on cloud-based technologies since the beginning of his career. He has been involved in development and implementation of Private Cloud as well as Hybrid Cloud. He has also worked on public clouds such as Amazon web services. He has worked extensively with open source technologies in the Cloud Computing space and on the Apache CloudStack platform.

He has also co-authored another book on Cloud Computing which is self-published on Amazon.com and Createspace.

I would like to thank my family and friends, my co-author Navin Sabharwal and my colleagues Piyush Pandey, Dheeraj Raghav and Lokesh Chanana for their guidance, mentoring, and continuous support. I would also like to thank Prof. Ravindra Dastikop, the team at Packt Publishing, Wilson D'souza, Mary Nadar, Yashodhan Dere, Anish Ramchandani, Nitee Shetty, Vrinda Nitesh Bhosale, Arshad Sopariwala, and Sweny Sukumaran for the support and guidance for writing this book.

For More Information:
Apache CloudStack
Cloud Computing

Apache CloudStack is an open source software for building public and private clouds. It is now a global success, and is developed and supported by scores of people around the globe as well as backed by some of the leading players in the cloud space today. This book is specifically designed to quickly help you get up to speed with Apache CloudStack and give you the confidence and understanding to roll it out in your own datacenters. From the installation of CloudStack to helping you implement production environments, this book covers a wide range of topics that help you get started with Apache CloudStack.

This book will show you:

- The architecture and core components of CloudStack along with the installation process to run an environment that can be managed and operated just like AWS, HP Cloud Services, and Rackspace.
- How to master the complete private CloudStack, from scaling out compute resources to managing object storage services for highly redundant and highly available storage.
- Practical, real-world examples of each service built upon in each chapter, allowing you to progress with the confidence that they will work in your own environments.
- Detailed screenshot-by-screenshot instructions on how to configure various features and use them.
- *Apache CloudStack Cloud Computing* gives you clear, step-by-step instructions to install and run your own cloud successfully. It is full of practical examples that enable you to use the latest capabilities of CloudStack and implement them.

For More Information:
What This Book Covers

Chapter 1, Apache CloudStack Architecture, introduces you to Cloud Computing, the architecture of Apache CloudStack, and the various components of Apache CloudStack along with its various deployment models.

Chapter 2, Installing Apache CloudStack, walks you through the installation steps of Apache CloudStack and the setting up of Apache CloudStack in an organization.

Chapter 3, Apache CloudStack Configuration, introduces you to the CloudStack management console and the setting up of the IT infrastructure and configuring CloudStack to provide cloud services.

Chapter 4, Apache CloudStack Networking, teaches you about the CloudStack networking components and shows you how to set up network offerings in CloudStack and various options available in CloudStack for setting up the networks.

Chapter 5, Apache CloudStack Storage, teaches you about the storage architecture in CloudStack, and the various kinds of storage options in the cloud, and also walks you through the steps of creating and managing various storage offerings in the cloud.

Chapter 6, Service Offerings and Virtual Machines, teaches you about the various service offerings available in CloudStack and also describes the virtual machine's life cycle in Apache CloudStack.

Chapter 7, Domains, Accounts, Projects, and Users, teaches you about the management of domains, accounts, projects, and users in Apache CloudStack.

Chapter 8, High Availability and Scaling, teaches you about high availability and scaling configuration options in Apache CloudStack for setting up Apache CloudStack in HA mode as well providing services in HA. It also introduces you to the various components of Apache CloudStack to maintain high availability.

Chapter 9, Extending Apache CloudStack and Performance Tuning, teaches you about the various options and modules of CloudStack so as to extend its functionality and also walks you through the steps to tune the performance of Apache CloudStack.

For More Information:
In the previous chapters, we explained the utilization of storage in the cloud and various types of storage devices supported by CloudStack and role of these storages. In this chapter we will introduce you to the following:

- Offerings and their purpose in the cloud
- Various types of offerings supported by CloudStack
- How users can use these offerings to request resources from the cloud
- The virtual machine lifecycle

**Introducing service offerings and virtual machines**

Service offerings are an integral part of any cloud service. The service offerings are used by the cloud administrators to define the services that the users can request from the cloud. Based on the service offering configuration, the users are granted resources.

For More Information:
Service Offerings and Virtual Machines

As an example the cloud provider can configure and define services in the areas of compute, network, storage, and common services such as DHCP, DNS, and so on. These offerings can be made available to the users and then be subscribed by the users. In CloudStack the service definition includes the compute offerings, disk offerings, network offerings and system offerings. End users request resources by selecting any of the offerings defined by the cloud provider. For example, if a user has to request a virtual machine, then he can select the template or ISO file, compute offering and disk offerings based on which the virtual machine will be created.

In this chapter we are going to discuss the basic role of service offerings, service offering configurations and how the users use it to request resources from the cloud.

The different types of service offerings in CloudStack are:

**Compute offering**

This service offering is defined for the compute resources for the guest VMs in the cloud.

In this offering, the administrators define the amount of CPU in terms of cores as well as the processing speed of a CPU in Mega-Hertz, the amount of memory, the network rate, and other resources.

When a user requests a unit from this offering, the resources mapped with the service offering are provided to him. CloudStack tries to match the logical value of MHZ with the value provided in the compute offering.

The administrators can create a compute offering from the Service offering page, using the following steps:

1. Go to **Service offering**, select the **compute offerings** option from the drop-down menu.
2. Click on **Add compute offering**, you should get the following screen:

   For More Information:  
3. Fill in the fields described as follows:

- **Name**: This field gives the name of the compute offering.
- **Description**: This field gives the description of the compute offering.
- **Storage Type**: This field lets you select the storage type which is to be used in this offering. It can be either shared or local storage. When local storage is selected, the storage from the local host is selected to provide the storage for the guest created from this compute service offering.
- **# of CPU Cores**: This field specifies the number of CPU cores that should be allocated to the guest created from this offering.
- **CPU in MHz**: This field specifies the speed of CPU cores that should be provided to the guest instance. It is specified in MHz.
- **Memory (in MB)**: This field specifies the amount of memory to be allocated to the guest.
- **Network Rate**: This field specifies the network rate in Mbps.
- **Offer HA**: This field allows monitoring the guest and making it as highly available as possible. This field places the guest host on a HA-enabled host.

For More Information:

Service Offerings and Virtual Machines

- **Storage Tags**: This field specifies the storage tags that are to be used while provisioning the guest. The storage tag is matched with the tags of the primary storage added to CloudStack. When a user requests a virtual machine using a service offering, the primary storage matching to the service offering is used to allocate storage to the guest.

- **Host Tags**: This field specifies the host tag which is to be associated with this service offering. This tag must match with the tag that has been used to organize the host in the infrastructure. The host with the matching tag is associated with this service offering.

- **CPU Cap**: This field is to limit the amount of CPU available to the user to an assigned value even if there is spare capacity available.

- **Public**: This field is provided for the visibility of the service offering. Public means that this offering will be available to all the domains in the Cloud. If you don't want this offering to be public, CloudStack will let you configure the scope of visibility of the offering. We can define the scope of the visibility of the offering to a subdomain. CloudStack will prompt to select one of the subdomains from the drop-down list.

The guest VMs can be tagged as **Highly Available (HA)**. This is enabled by selecting the **Offer HA** option. CloudStack provides a global configuration parameter, `ha.tag`, to set the hosts which can be used for HA enabled guests only. If the guest is selected to **Offer HA**, it will be provisioned on the hosts dedicated for HA enabled VMs.

In case of VMware hypervisor, CloudStack uses the native HA feature provided by VMware.

In case of KVM/XenServer, CloudStack uses the storage heartbeat to detect if the HA is to be performed or not for the HA enabled guest VMs. The agent resides on the XenServer/KVM continuously writes the time stamp on the shared storage, and in case the storage ping times out the HA job will be started for the guest VMs that are HA enabled.

The HA service is installed on the host, but the cluster is the basic unit of availability in CloudStack, so all hosts in the cluster must be enabled for cluster uniformity.
Disk offering

The other type of service offering is related to the disk or the storage resource. The disk offering is used by users to request storage from the cloud. The administrator defines different types of disk offerings based on the size and type of storage that the users can request from the cloud.

When a user requests storage using one of the disk offerings, the resources mapped to that offering are allocated for consumption.

The steps for defining a disk offering are discussed as follows:

1. Go to Service offering and select disk offering in the drop-down menu.
2. Click on Add Disk Offering and you should see the following screen:

3. Fill in the following fields:
   - **Name** and **Description**: This field specifies the name and description of the disk offering that you are creating.
   - **Custom Disk Size**: This field specifies that the users can define a custom disk size of their own choice, or else the administrators define a fixed size of disk with this service offering.
   - **Disk Size (in GB)**: This field specifies the size of the disk to be associated with this service offering.

For More Information:
Service Offerings and Virtual Machines

° **Storage Tags:** This field specifies the storage tags which are to be associated with this service offering. These storage tags are used by CloudStack to match with the storage tag associated with the storage added to CloudStack. When a user requests a volume using this disk offering, the tags are matched with the primary storage in the CloudStack and a disk with the configuration in the offering is provided to the user.

° **Public:** This option is for the permission associated with this disk offering.

System service offering

The system service offerings are used for creating the CloudStack system VMs such as virtual router, console proxies, and other system virtual machines. The system service offering is used to create virtual machines that are used by CloudStack to manage and provide services to the cloud. These system service offerings are used while creating a new network offering (to be discussed next). When the administrator creates a new network offering that has services such as DHCP, DNS, and security group, these services are provided by the system VMs of type Domain router in the CloudStack which can be created using one of the system service offerings.

While defining the system service offering, we provide the information about System VM Type. CloudStack provides some default system service offerings. System service offering provides a way to create custom system offerings and use them for creating system VMs.

In order to create a new system service offering, follow the given steps:

1. Go to the service offering page and select system offering from the drop down menu.
2. Click on **Add System Service Offering**, and you should get the following screen:

For More Information:

The preceding screen has the same options and fields as creating a new compute offering. For more details please see Chapter 4, *Apache CloudStack Networking*.

The other type of service offering is the network offering. The network offering is used to create a network service. Whenever an administrator creates a new network in any zone, a network offering is selected based on which the new network will have the services and scope. The network offering defines the kind of network services which are included with it. A more detailed insight of creating a network offering was discussed in the previous chapter.

The CloudStack system VMs are based on some system service offerings. For example, a security group service in a network is provided using the CloudStack virtual router, whereas a Firewall service in a network can be provided using the CloudStack virtual router or a hardware device. The networks are created using these network offerings.
The complete process
The various types of service offerings are used to create guest VMs by the user and system VMs by the CloudStack. We will see the steps followed by CloudStack when the user requests a VM. A user can add an instance from the instances page. When a user requests a new VM instance, the steps shown in the following screenshot take place:

Let's take look at these steps:

1. The user selects the zone in which he wants the VM instance to be created. The network configuration or optional network services such as DHCP, routing, and load balancing, are already provisioned for the zone while the zone was created.

2. If the user has privileges over these services in the zone, the services are provisioned for the virtual machine being requested.

For More Information:

3. The user then selects the source of the VM instance, that is a template or an ISO image. The VM instance will inherit all the features as per the selection of the user. If a user selects a template, then all the resources and configuration in the template is provided in the VM instance. And when the user selects the ISO image, the VM instance is created and the ISO is loaded into the CD ROM drive of the guest. The instance boots into the virtual machine BIOS and the user can install the operating system from the ISO image by opening the console of the guest virtual machine from the CloudStack Web UI.

4. Based on the selection of source of the VM instance, the user selects the ISO image or template for the VM, from the list shown in the next screen:
Service Offerings and Virtual Machines

5. The user then selects the Compute and Disk offering which is to be used to provide the root volume of the VM instance. The data volume of the VM instance is created using the disk offering selected by the user and is provided from the primary storage of the cluster.

6. If the user selects any extra data volume, then it is provided from the primary storage of the cluster or the local storage based on the offering selected. The local storage option is available for XenServer, KVM, and VMware Hypervisors.

7. After choosing the required Compute offering, the user must select the Data Disk Offering for the guest instance, as shown in the following screen:
8. After the user has provided the basic information for the VM instance to be created, CloudStack initiates the copy of the template or the ISO from the secondary storage of the zone to the primary storage of the cluster. CloudStack also tries to localize the services for the accounts to as few clusters as possible to ensure security and optimize the performance of the provisioned services.

9. After the copy of the template or the ISO is done, CloudStack instructs the host to create the VM instance using the template or ISO on the primary storage and then start the instance.
Service Offerings and Virtual Machines

After the VM instance is provisioned, the user can perform certain operations on it such as stopping, starting, and terminating. The following figure shows the state diagram of the VM lifecycle. Once the instance has been terminated, it can still be recovered. After the guest VM is terminated, the users have the option to restore the images. The next state of the guest VM is the Expunged state, which destroys the guest VM permanently, meaning that the instance cannot be recovered. By default, the Expunged state interval is set to be 86400 seconds. The administrator can change the Expunged state interval value by changing the configuration parameter from the global settings page. The global setting parameter which you can use to change the expunged state interval is `expunge.interval`.

Once the VM is created, the user can perform the operations on it as described in the following sections.

Accessing the VM

After the VM instance is created, the user will need to access it and perform operations on it such as deploying applications, and testing them. The user can access his/her instance by using the following steps:

1. Go to the instance page by clicking on **Instances** in the left panel.
2. Select the instance that you want to access.
3. Click on the **View Console** button.

For More Information:  
The user can also access the VM instance directly, but before this the user must ensure that the SSH port is open on the Firewall, otherwise the user needs to disable the firewall to access the guest VM instance.

In cases where SSH is not enabled in the instance, the user will not be able to remotely access the VM via SSH. This depends upon the template or ISO from which the instance was created. In order to enable the access via SSH, the user must access the VM from the console and enable SSH before accessing it directly.

In case of a basic network zone, if the user wants to perform operations which require other ports on the instance, he must provide a rule in the security group which should allow the communication on that port from a desired source.

If there is some other external firewall protecting the VM instance, the user will have to add rules to allow the communication for accessing the VM directly.

For More Information:
Starting, stopping, rebooting, and destroying the VM instance

After the VM instance is created, the user can perform these operations directly from the console by right-clicking on the VM instance. The user can stop the instances which will shut down the operating system by shutting down all the applications. The user can also reboot the instance or destroy the instance.

Once the guest is destroyed, the VM can still be recovered until it is not expunged. After the instance is destroyed, the guest is expunged after the expunge interval. Once the VM is expunged, it cannot be recovered. When the instance is destroyed all the resources that are being used by it are reclaimed and given back to the resource provider. The volumes associated with the VM are deleted and recollected by the primary storage. We can see these icons in the following screenshot:

Live migration of VMs between hosts

CloudStack allows live migration of the VM instance, both automatically and manually. CloudStack live migrates a guest VM instance if the High Availability feature is enabled in the service offering from which the guest has been created. CloudStack also live migrates the VMs from the host which is marked for maintenance to another host in the cluster in order to prevent any disruption of service. The manual live migration operation can only be performed by the root administrator of CloudStack who belong to, root domain's admin account.

For More Information:
The root administrator can move a VM instance from one host to another host without any interruption to the services to the users or without going into maintenance mode. The VM instance must be in the running state for this operation and there should be resources on the destination host so that it can accommodate the VM. If the destination host doesn't have enough resources for the VM, the VM will remain in the migration state until it gets all the resources on the destination host. The VM that is to be migrated must not have any local disk associated with it.

In case the VM is running on OVM, the VM must not have any ISO attached to itself because the instance with attached ISO cannot be live migrated on OVM.

The administrator can also set some parameters such as the retry time interval for migration when it fails, and the wait time before the migration finishes. These parameters are given as follows and are shown in the following screenshot:

- **migrate.retry.interval**: This parameter defines the time interval between the retries of VM migration
- **migratewait**: This parameter defines the time in seconds before VM migration is complete

For More Information:

The administrator can also migrate the instance manually. To do this, use the following steps:

1. Go to the instance page by clicking on the **Instances** tab on the left panel.
2. Click on the instance that needs to be migrated.
3. Click on the **Migrate instance to another host** button.
4. This will open the option to select the host to which the VM is to be migrated.
5. Select the destination host and click on **OK**.

The administrator can also perform various other operations from the console after the VM has been provisioned such as detaching the ISO, editing the service offering that was used to create the VM (the VM must be stopped before doing this), resetting your password, and editing the details of the instance. The CloudStack Web UI also provides the console for viewing the details such as statistics of the VM instance and the extra network interfaces that are attached to the VM.

**CloudStack with different hypervisor**

CloudStack follows different steps depending upon the hypervisor on which the VM instance is to be created; this is because CloudStack integrates with different hypervisors differently. We are going to discuss how CloudStack integrates with different hypervisors.

For More Information:

Citrix XenServer

In case of Citrix XenServer, a XenServer poll master is created using the XenCenter client which contains various hosts. While doing this CloudStack adds all the slave hosts in the XenServer pool master. The system VM control channel and the network management both work at the host level. Refer to the following screenshot:

Oracle VM

In case of Oracle VM, CloudStack integrates with the OVS-agent deployed on the hosts and doesn't use the OVM manager. CloudStack itself configures the ocfs2 nodes. There are various types of templates provided by Oracle such as the DB frameworks application built-in which helps the customers to quickly deploy the Oracle services. In this case, CloudStack requires a helper cluster to support the creation of the OVM instance. The domain router is automatically created in the helper cluster when the first OVM instance is created. The OVS agent helps in storing data in the local database on the host. Obviously, only supported OS types are provisioned on the Oracle host. All the Linux/Solaris templates must be obtained from the Oracle site whereas Windows can be installed from an ISO on Oracle VM hosts. Oracle recommends the usage of iSCSI devices for storage while using Oracle VM. It is the user's responsibility to set up the iSCSI device on every host.

For More Information:
While using OVM, there are certain limitation like CloudStack needs a helper cluster such as XenServer or KVM or VMware to support OVM hosts and the system VM cannot be deployed on these hosts because OVM doesn't support Debian guests.

RedHat Enterprise Linux (KVM)

In case of RHEL KVM, CloudStack integrates directly with libvirt and Qemu using the cloud agent and manages the snapshots, system VM control channel, and networks at the host level. CloudStack supports RHEL 6+ and Ubuntu 12.04-based KVMs. In fact, CloudStack depends on the libvirt and Qemu versions, so if you are using any other operating system, make sure the following versions are available:

- Libvrt v0.9.4 or higher
- Qem or KVM, v1.0 or higher
VMware vSphere

In case of VMware vSphere, CloudStack integrates using the VCenter. CloudStack supports system VM control channels using the CloudStack private network and deploys a system VM on the hosts to manage the snapshot and the volume. The networking, in case of the VMware cluster, is managed using the vSphere vSwitch. While adding a VMware based zone, it is recommended to create a cluster of hosts on the vCenter and then add the cluster to the CloudStack. The vCenter cluster is mapped directly to a CloudStack cluster under the Pod.

The vCenter cluster integrated with CloudStack can only belong to one vCenter datacenter because the scope of the vCenter datastore used by the vCenter cluster is limited to one vCenter datacenter and the scope of the vCenter vSwitch that is being used by the vCenter cluster is limited to one vCenter datacenter. When a vCenter datacenter resource is shared outside of CloudStack, it may create problems.

When a new VMware cluster is added to the CloudStack, the CloudStack management server bootstraps a system VM and a secondary storage VM to manage the secondary storage which helps in template processing and volume, snapshot or template operations.

For More Information:
CloudStack manages network in VMware using the vCenter vSwitch. The setup of vSwitch and NIC-bonding is done through the vCenter. CloudStack creates networks by creating portgroups dynamically and propagates the network across the cluster which helps in independent VM live migration both in CloudStack and vCenter. The vCenter default vSwitch ports usually need to be extended to support the networks in CloudStack.

CloudStack takes snapshots at the volume level whereas a snapshot in vCenter is taken at the VM level. Use the following steps to take a snapshot:

1. The user creates a VM snapshot, or if it is for a detached volume in CloudStack, a new worker VM is created.
2. The VM snapshot meta-data is processed and CloudStack builds the disk chain information at the volume basis.
3. A new intermediate VM is created on top of the selected disk chain.
4. The full back up of the VM is exported to the secondary storage and CloudStack proceeds with the cleanup process to remove the resources created while this process.

The summary of CloudStack integration with different types of hypervisors is depicted in the following diagram:

For More Information:
Summary

In this chapter we covered the various types of offerings and the configuration of the same. We also discussed the various types of offerings that are supported by different hypervisors in CloudStack. In the next chapter, we will introduce to you to the concept of domains, accounts, projects, and users in the CloudStack, and their use to isolate different types of users in the cloud.
Where to buy this book


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