Experiment No. 5

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Aim: Provide a study of OpenStack.

Introduction:

OpenStack is a cloud operating system that is used to manage a data center's massive pools of computing, storage, and networking resources. OpenStack is a free and open-source software platform. This is essentially an IaaS (infrastructure as a service) for cloud computing.

OpenStack is a software framework that creates and manages private and public clouds using pooled virtual resources. Many cloud-related services (such as networking, storage, image services, identification, and so on) are included by default in OpenStack. Users can access this information via a web-based dashboard, a RESTful API, or command-line tools. OpenStack manages a large number of virtual machines, allowing for more efficient use of physical resources.

Components of OpenStack:

Compute (Nova):

Compute is a resource management controller for virtualized systems. It manages a number of virtual machines and other instances that carry out computations.

Object Storage (Swift):

Object storage is used to store and retrieve arbitrary data on the cloud. Files, objects, backups, photos, movies, virtual machines, and other unstructured data can all be stored in Swift. In place of the path, which directly points to a file and allows OpenStack to control where to store the files, developers can use a custom identifier to refer to the file and objects.

Block Storage (Cinder):

This operates in the same way that an external hard drive is attached and detached from the OS for local use. Cinder is in charge of adding, removing, and creating new disc space on the server. This component offers virtual storage for the system's virtual computers.

Networking (Neutron):

In OpenStack, this component is utilised for networking. Neutron is responsible for all network-related queries, including IP address management, routers, subnets, firewalls, VPNs, and so on. It verifies that all of the other components are properly connected to OpenStack.

Dashboard (Horizon):

This is the first thing a user sees when they open OpenStack. Horizon is a web UI (user interface) component that allows you to interact with the other back-end services. Developers can access OpenStack components using distinct APIs

(application programming interfaces), but system administrators can use the dashboard to see what's going on in the cloud and control it as needed.

Identity Service (Keystone):

It serves as a central repository for all users and their permissions for OpenStack services. This component is responsible for managing identity services such as authorization, authentication, AWS Styles (Amazon Web Services) logins, token-based systems, and other credential checks (username & password).

Image Service (Glance):

The OpenStack image services are provided by the look component. The images or virtual copies of hard discs are referred to as image services. When we want to create a new virtual machine instance, we may use these photos as templates with Glance. Virtual box (VDI), VMware (VMDK, OVF), Raw, Hyper-V (VHD), and KVM (qcow2) virtual images are all supported by Glance.

Telemetry (Ceilometer):

It's used to track consumption and report it to specific OpenStack users. In a nutshell, Telementry is a billing service provider for OpenStack's individual customers.

Orchestration (Heat):

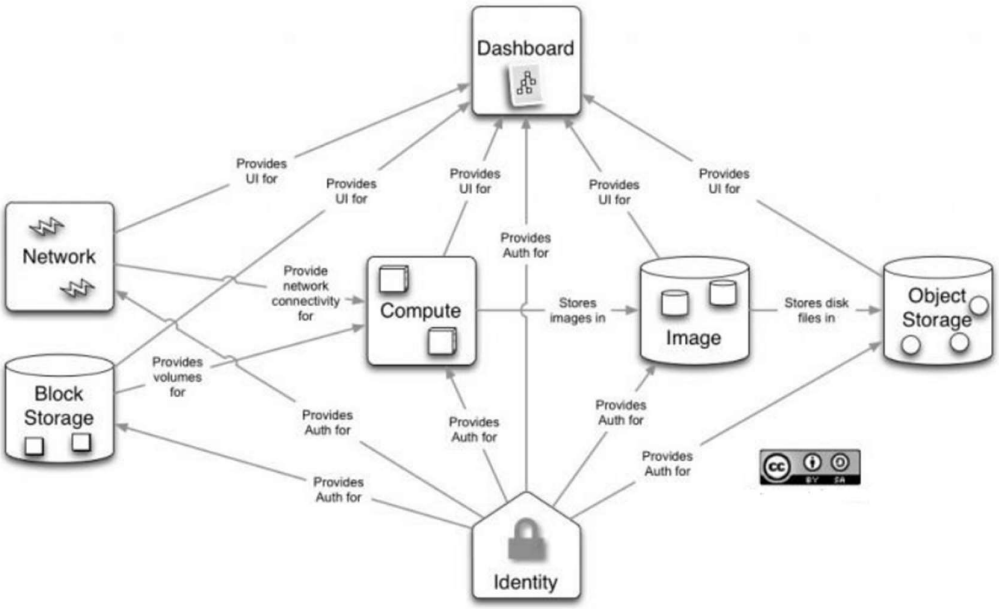
It enables developers to save the cloud application's requirements in a file, ensuring that all necessary resources are readily available. Through the templates, this component arranges numerous sophisticated cloud applications using both the local OpenStack REST API and the Query API.

Shared File System (Manila):

It provides a virtual machine with file storage. The infrastructure for managing and provisioning file shares is provided by this component.

Elastic Map-reduce (Sahara):

The Sahara component provides users with a straightforward way to plan Hadoop clusters by referring to many factors such as Hadoop version, cluster topology, and node hardware specs, among others.



How does OpenStack Work?:

OpenStack is just a set of commands known as scripts. These scripts are then packaged into projects, which are based on tasks that generate cloud environments.

In order to create specific environments, OpenStack relies on two different types of software:

- Virtualization is a term that refers to a layer of virtual resources that is separated from the hardware.
- A base operating system that runs commands generated by OpenStack Scripts.

Horizon, as we all know, is a user interface for the appliance environment. The Horizon should be used for anything the user wishes to do (Dashboard). The Dashboard is a simple graphical user interface with numerous modules, each of which performs a different function.

The service API call is the foundation of all OpenStack actions. So, if you're doing something, you're probably calling a service API. Keystone verifies each API call before it is used. Before you can access the OpenStack dashboard, you must first log in as a registered user with your login username and password.

After successfully logging in to the OpenStack dashboard, you'll see a variety of options for creating new instances, volumes, Cinder, and network configuration.

A virtual machine or environment is what an instance is. Use the 'instances' option from the OpenStack dashboard to create a new VM. You can setup your cloud in these situations. RedHat, OpenSUSE, Ubuntu, and other distributions can be used as instances.

An API call is also used to create an instance. Instances can be configured with network information. To add further services, connect these instances to the cinder instance or volume.

You can configure an instance after it has been successfully created, you can access it through CLI, and you can add any data you want. You may also create an instance to manage and store the snapshots for future use or backup.

AWS v/s OpenStack:

OpenStack	AWS
OpenStack is categorized as Cloud Management Platforms and Infrastructure as a Service (IaaS).	AWS Lambda is categorized as a Cloud Platform as a Service (PaaS).
Glance handles the images.	AMI (Amazon Machine Image) handles the images.
LBaaS of OpenStack handles the load balance traffic.	The ELB (Elastic Load Balancer) automatically distributes the incoming traffic from the services to the EC2 instances.
Each virtual instance will automatically be allocated an IP address. It is handled by DHCP.	AWS allocates a private IP address to every new instance using DHCP.
Identity authentication services are handled by Keystone.	Identity authentication services are handled by IAM Identity and Access management.
Swift handles object storage.	Object storage is managed by S3 (simple storage service) bucket
A cinder component manages block storage.	Block storage is managed by EBS (Elastic Block Storage)
OpenStack provides MYSQL and PostgreSQL for the relational databases.	Users of AWS use an instance of MySQL or Oracle 11g.
OpenStack uses MongoDB, Cassandra, or Couchbase for a non-relational database.	For a non-relational database, AWS uses EMR (Elastic Map Reduce).
For networking, OpenStack uses Neutron.	For networking, AWS uses VPC (Virtual Private Cloud).
Machine learning (ML) and NLP (Natural Language processing) are not readily available.	Machine Learning (ML) and NLP (Natural Language processing) are possible in AWS.
OpenStack has no Speech or Voice recognition solution.	Lex is used for speech or voice recognition solutions.
It has the Mistral - Workflow Service.	It follows the Simple Workflow Service (SWF).
Ceilometer - the Telemetry based billing, resource tracking etc.	AWS Usage and the Billing Report.
No Serverless Framework.	Lambda is a serverless framework.

Benefits of OpenStack:

1. **Open Source**
   As we all know, we can build a completely defined data centre utilising the open-source ecosystem. The largest open-source platform is OpenStack. It is a single platform that includes networking, compute, and storage components. Some vendors (such as RedHat) have developed and continue to support their own OpenStack distributions.
   The open-source OpenStack project has two major advantages:

- OpenStack may be customised to meet your changing needs - you can add additional functionality to OpenStack as needed.
- It can be used without constraints - Because OpenStack is a freely open project, there are no restrictions or limitations on how it can be used. You are free to use it how you see fit. There are no restrictions on what you can use it for, where you can use it, or how long you can use it.

2. **Scalability**
   Cloud computing's most important feature is scalability. For organisations, OpenStack provides more scalability. It allows businesses to spin up and down servers on demand thanks to this feature.
3. **Security**
   One of the most important elements of OpenStack is security, which is one of the main reasons for its popularity in the cloud computing market.
   - Your data is always secure with OpenStack - When business owners consider moving their IT infrastructure to the cloud, they are constantly concerned about data loss. With OpenStack, however, there is no need to be concerned about data loss. It has the highest level of security.
   - Security professionals who are responsive to OpenStack's high security are provided by OpenStack.
4. **Automation**
   When compared to other options, one of the main selling features of OpenStack is automation. OpenStack is efficient because it is simple to automate tasks. OpenStack provides with a number of built-in technologies that make cloud management much more efficient and straightforward. OpenStack has its own API (Application Program Interface) that allows other apps to operate the cloud completely. This feature makes it simpler to create your own apps that can interface with OpenStack and execute tasks like launching virtual machines.
   DEVELOPMENT SUPPORT
   - Because the source code for OpenStack is open source, it may be improved by specialists from all over the world. A development team can easily and professionally build a new feature if one is being created. OpenStack is similar to Linux in that it comes in a variety of flavours, each with its own set of features, but all share the same core component.
   - Assistance from corporations - OpenStack receives development support from companies like as Intel, IBM, AT&T, Cisco, Red Hat, Dell, Ubuntu, and others. It's changing by leaps and bounds, which is a huge benefit for you.
   - The developer community's support - OpenStack is being improved by a large number of developers. They are working hard to improve OpenStack on a regular basis.

5. **Easy to access and manage**
   The major benefit for you is that we can quickly access and control OpenStack. Because of the following features, OpenStack is simple to use and manage:
   - Command-Line Tools - We can use command-line tools to access OpenStack.
   - Dashboard - OpenStack provides a GUI (graphical user interface) based dashboard component that allows users and administrators to access

and manage many parts of OpenStack. It has a web-based user interface.

- APIs (Application Program Interface) - A large number of APIs (Application Program Interface) are used to control OpenStack.

6. **Services**
   OpenStack delivers a variety of services that are necessary for a variety of jobs in your public, private, or hybrid cloud.
   OpenStack provides a number of services and components, including Nova, Cinder, Glance, Keystone, Neutron, Ceilometer, Sahara, Manila, Searchlight, Heat, Ironic, Swift, Trove, Horizon, and others.
   Each component has a distinct purpose. Nova offers compute services, Neutron offers networking services, and Horizon offers a dashboard interface, among other things.
7. **Strong Community**
   OpenStack has a large community of specialists, developers, and users who enjoy collaborating to improve the product and features of OpenStack.
8. **Compatibility**
   OpenStack is interoperable with public cloud platforms such as Amazon Web Services (AWS).

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