**OpenNebula: Open Source IaaS Cloud Computing Software Platforms**

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Abstract—OpenNebula combines existing virtualization technologies with powerful features for automatic provision, multi-tenancy, as well as elasticity, following a bottom-up approach driven by real needs of sysadmins and devops. OpenNebula exists to help companies build simple, reliable, cost-effective, open enterprise clouds on existing IT infrastructure, and also brings beauty, peace of mind, simplicity to private and hybrid enterprise cloud. In this research paper, we are discussing about Introduction to Cloud Computing, with its important benefits. Further discussing about OpenNebula technology, with its key features, OpenNebula system, components of an OpenNebula system as well as interfaces provided by OpenNebula and at last covering Reasons for using OpenNebula as well as comparison between OpenStack and OpenNebula. The aim of this paper is to show importance of OpenNebula technology and also provides most simple but feature rich as well as flexible solution for comprehensive management of virtualized data centers to enable on-premise IaaS clouds.

Keywords—Cloud Computing; IaaS; KVM; OpenNebula; VMs

**I. INTRODUCTION**

In last few years, Information Technology has embarked on a new paradigm; cloud computing. Cloud computing is only a different way to deliver computer resources, rather than a new technology, as well as it is a comprehensive solution that delivers IT as a service. Cloud Computing is an Internet based computing solution where shared resources are provided like electricity distributed on electrical grid. Cloud computing easily increases efficiency, helps improve cash flow and offers many more benefits like Flexibility, Disaster recovery, Automatic software updates, Cap-Ex Free, Increased collaboration, Work from anywhere, Document control, Security, Competitiveness, Environmentally friendly etc.

![Cloud Computing](image)

**Fig. 1: Cloud Computing**

**II. OPENNEBULA**

OpenNebula is a powerful, adaptable and interoperable open-source platform for data center virtualization as well as enterprise cloud management that provides most simple but feature-rich and flexible solution for comprehensive management of virtualized infrastructure in data center to enable on premise IaaS clouds. OpenNebula supports Hybrid Cloud to combine local infrastructure with public cloud-based infrastructure, enabling highly scalable hosting environments, as well as it also supports Public Clouds by providing Cloud interfaces to expose its functionality for virtual machines (VMs), storage and network management.
III. OPENNEBULA KEY FEATURES

OpenNebula is a cloud computing toolkit which is used for managing heterogeneous distributed data center infrastructures. OpenNebula that now operates as an open source project began as a research project by Ignacio M. Llorente and Rubén S. Montero in 2005, as well as it is free, open-source software, subject to requirements of Apache License version 2, and also first public release of OpenNebula was in March 2008. The toolkit contains features for integration, scalability, management, security and accounting. It claims interoperability, standardization, as well as portability, providing cloud users and administrators with a choice of several cloud interfaces like Amazon EC2 Query, OGF Open Cloud Computing Interface etc. and hypervisors like Xen, KVM etc., and can accommodate multiple hardware and also software combinations in a data center.

IV. INTERFACES PROVIDED BY OPENNEBULA

OpenNebula is an open-source Cloud Management Tool, and its open, architecture, interfaces as well as components provide flexibility and extensibility that many enterprise IT shops need for internal cloud adoption. OpenNebula also provides an abstraction layer independent from underlying services for security, networking, virtualization, and storage, avoiding vendor lock-in and enabling interoperability. It is not only built on standards, but has also provided reference implementation of open community specifications. Open as well as flexible approach for cloud management ensures widest possible market and user acceptability, and also simplifies adaptation to different environments.
OpenNebula provides interfaces that can be used to interact with functionality offered to manage physical as well as virtual resources, and four main different perspectives to interact with OpenNebula such as:

- Cloud interfaces for **Cloud Consumers**, such as EBS interfaces, EC2 Query etc.
- Administration interfaces for **Cloud Advanced Users and Operators**, such as command line interface, Sunstone GUI
- Extensible low-level APIs for **Cloud Integrators** in JAVA, Ruby, XMLRPC API
- Marketplace for **Appliance Builders**

![Fig. 4: OpenNeba](image)

**V. REASONS FOR USING OPENNEBULA**

OpenNebula is a powerful open source management tool that helps virtualized data centers enable private clouds, public clouds as well as hybrid clouds. It combines existing virtualization technologies with advanced features for multi-tenancy, elasticity and automated provisioning. OpenNebula can use KVM, Xen or VMware hypervisors, and it is vendor neutral, as well as also platform- and API-agnostic. Here, we are discussing some important reason for using OpenNebula such as:

- Mature, Innovative and Powerful
- Fully platform independent and Enterprise class Product
- Open, adaptable and extensible architecture, interfaces and components
- Cloud interoperability and portability
- Truly open-source code and Infrastructure Agnostic
- Easy to download, install and update
- Scalability, reliability and performance
- Wide variety of commercial and community support

**VI. OPENNEBULA SYSTEM**

OpenNebula requires a cluster-like setup with a single frontend, containing management interface as well as a bunch of cluster nodes. Use frontend node as a cluster node, in a small infrastructure, but in big infrastructures, frontend node could require a lot of memory, CPU, as well as disk resources that should be placed on a dedicated node. Basic components of an OpenNebula system such as:

- **Frontend**: Frontend executes OpenNebula services.
- **Hosts**: These are basically hypervisor enabled nodes that will physically run infrastructure.
- **Datastores**: Datastores holds base images of VMs.
- **Physical network**: Physical network provides VLAN for VMs infrastructure links.
VII. COMPARISON BETWEEN OPENSTACK AND OPENNEBUALA

<table>
<thead>
<tr>
<th>S. No.</th>
<th>OpenStack component</th>
<th>Equivalent to OpenNebula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Compute (Nova)</td>
<td>built-in</td>
</tr>
<tr>
<td>2</td>
<td>Object Storage (Swift)</td>
<td>not equivalent</td>
</tr>
<tr>
<td>3</td>
<td>Image Service (Glance)</td>
<td>built-in</td>
</tr>
<tr>
<td>4</td>
<td>Identity (Keystone)</td>
<td>built-in</td>
</tr>
<tr>
<td>5</td>
<td>Dashboard (Horizon)</td>
<td>Sunstone</td>
</tr>
<tr>
<td>6</td>
<td>Networking (Neutron)</td>
<td>built-in</td>
</tr>
<tr>
<td>7</td>
<td>Block Storage (Cinder)</td>
<td>built-in + plugins</td>
</tr>
<tr>
<td>8</td>
<td>Telemetry (Ceilometer)</td>
<td>built-in</td>
</tr>
<tr>
<td>9</td>
<td>Orchestration (Heat)</td>
<td>flow</td>
</tr>
<tr>
<td>10</td>
<td>Database Service (Trove)</td>
<td>not equivalent</td>
</tr>
<tr>
<td>11</td>
<td>Data processing (Sahara)</td>
<td>not equivalent</td>
</tr>
<tr>
<td>12</td>
<td>Bare metal (Ironic)</td>
<td>not equivalent</td>
</tr>
<tr>
<td>13</td>
<td>Queue service (Zaqar)</td>
<td>not equivalent</td>
</tr>
<tr>
<td>14</td>
<td>Key management (Barbican)</td>
<td>not equivalent</td>
</tr>
<tr>
<td>15</td>
<td>DNS Services (Designate)</td>
<td>not equivalent</td>
</tr>
</tbody>
</table>

VIII. CONCLUSIONS

Cloud computing is an evolving technology, and OpenNebula cloud infrastructure provide elastic platform for scalability, fast delivery of services to meet dynamic demand of service end users. Open Source Software means that their source code available to user with or without fee. Open source cloud computing platform provide an alternative way to user for improved scalability, flexibility, portability as well as on demand services. This paper compares two most popular and commonly used open source software such as OpenStack and OpenNebula. Summarization as well as comparison allow users to choose better services according to their requirement.

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