An Overview of OpenNebula Project and its Applications

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OpenNebula orchestrates storage, network, virtualization, combining both data center resources and remote cloud resources, according to allocation policies. This paper provides insights into how OpenNebula can provide the right cloud services for unique needs of each organization.

Keywords: opennebula, open cloud, cloud computing

https://github.com/narayana1043/sp17-i524/blob/master/paper1/S17-IR-2017/report.pdf

1. INTRODUCTION

OpenNebula[1]is an open cloud platform using which each organization setup the right cloud for its organizational needs. This quite natural like it had happened with the databases and web-servers. As one cloud could not solve all the needs of various work environments OpenNebula helps in setting up and deploying cloud platform based on needs[2]. It is one of the solutions for the management of virtualized data centers with built-in features available for deployments in hybrid clouds.

Its interoperability makes cloud progress in developments of new methodologies to take advantage of the IT assets in turn saving investments and completely avoiding lock-in costs for the project. Its platform manages a data center's virtual infrastructure to build private, public and hybrid implementations of infrastructure as a service. Private cloud hosting, on the other hand, by definition is a single-tenant environment where the hardware, storage and network are dedicated to a single client or company.

The public cloud is defined as a multi-tenant environment, where consumers buy cloud services in a cloud computing environment that is shared with a number of other clients or tenants. Private cloud hosting, on the other hand, by definition is a single-tenant environment where the hardware, storage and network are dedicated to a single client or company. Hybrid cloud is mixture of both public and private clouds where one uses both public and private clouds.OpenNebula is a cloud computing platform for managing heterogeneous distributed data center infrastructures.

2. ARCHITECTURE OF OPENNEBULA

The OpenNebula platform manages a data center's virtual infrastructure to build private, public and hybrid implementations of infrastructure as a service. It provides features at two main layers of Data Center Virtualization and Cloud Infrastructure.

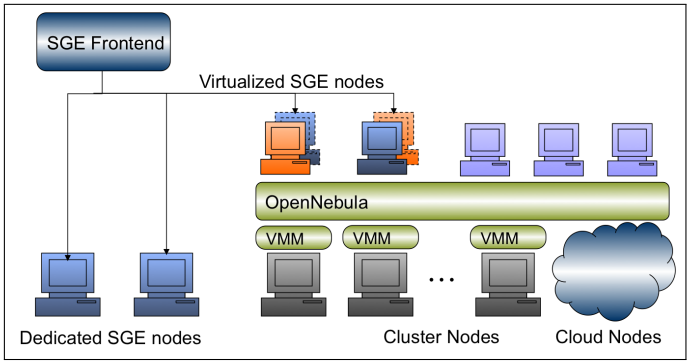

Fig. 1. The OpenNebula Engine for Data Center Virtualization and Cloud Solutions[3].

2.1. Data Center Virtualization Management

Many users use OpenNebula to manage data center virtualization[4], consolidate servers, and integrate existing IT assets for computing, storage, and networking. In this deployment model, OpenNebula directly integrates with virtual machine monitor(VMM) or hyper-visor and has complete control over virtual and physical resources, providing advanced features for capacity management, resource optimization, high availability and business continuity.

2.2. Cloud Management

OpenNebula also provides a multi-tenancy and cloud-like provisioning layer on top of an existing infrastructure management

solution where a single instance of a software application servers multiple customers. Each coustmer is called a tenant and each tenant may be given ability to customize some parts of the application. It helps in provisioning, elasticity and multi-tenancy cloud features like virtual data centers provisioning, data center federation or hybrid cloud computing to connect in-house infrastructure is managed by already familiar tools for infrastructure management and operation.

3. INTEGRATION, API'S AND LANGUAGE BINDING

OpenNebula has been designed to be adapted to most infrastructures and be extended with new components. Its interfaces hide most complexities of a cloud by and are suited to meet end user needs.

3.1. System Interfaces

It is a modular system that can implement a variety of cloud architectures and can interface with multiple data center services. It interfaces can be classified into 2 categories

1. end-user cloud interfaces
2. system interfaces

Cloud interfaces are primarily used to develop tools to the end-user, and they provide a high level abstraction of the functionality provided by the cloud. They are designed to manage virtual machines, networks and images through a simple and easy-to-use REST API. OpenNebula features a EC2 interface, implementing the functionality offered by the Amazon's EC2 API, mainly those related to virtual machine management. In this way, you can use any EC2 Query tools to access your OpenNebula Cloud.

System interfaces[5] expose the full functionality of OpenNebula and are mainly used to adapt and tune the behavior of OpenNebula to the target infrastructure. The XML-RPC interface is the primary interface for OpenNebula, exposing all the functionality to interface the OpenNebula daemon. The OpenNebula cloud API provides a simplified and convenient way to interface with the OpenNebula core XMLRPC API. OpenNebula also includes 2 language bindings for OCA: Ruby and JAVA. The OpenNebula OneFlow API is a RESTful service to create, control and monitor service to create, control and monitor services composed of interconnected VMs with deployment dependencies between them.

3.2. Infrastructure Integration

The interactions between OpenNebula and the Cloud infrastructure[6] are performed by specific drivers. Each one addresses a particular area:

Storage The OpenNebula core abstracts storage operations that are implemented by specific programs that can be replaced or modified to interface special storage back-ends and file systems.

Virtualization The interaction with the hypervisors are also implemented with custom programs to boot, stop or migrate a virtual machine. This allows you to specialize each VM operation so to perform custom operations.

Monitoring Monitoring information is also gathered by external probes. You can add additional probes to include custom monitoring metrics that can later be used to allocate virtual machines or for accounting purposes.

Authorization OpenNebula can be also configured to use an external program to authorize and authenticate user requests. In this way, you can implement any access policy to Cloud resources.

Networking The hypervisor is also prepared with the network configuration for each Virtual Machine.

4. ECOSYSTEM

The OpenNebula Ecosystem[7] is formed by external tools and extensions that complement the functionality provided by the OpenNebula Cloud Management Platform. In addition, the Ecosystems built around the cloud interfaces implemented by OpenNebula, Amazon AWS and OGC OCCI, can also be leveraged.

5. USE CASES OF OPENNEBULA

5.1. For the Infrastructure Manager

OpenNebula responds to infrastructure needs for services with dynamic resizing of the physical infrastructure by adding new hosts and dynamic cluster partitioning to meet capacity requirement of services. It has centralized management of all the virtual and physical distributed infrastructure. It can improve the utilization of existing resources in the data center and infrastructure sharing between different departments managing their own production clusters, so removing application silos. It improves operational saving with server consolidation to a reduced number of physical systems, so reducing space, administration efforts, power and cooling requirements. It has also reduced infrastructure expenses with the combination of locate and remote cloud resources so eliminating the over purchase of systems to meet peak demands.

5.2. For the Infrastructure user

It is built for fast delivery and scalability of services to meet dynamic demands of service end-users. It supports heterogeneous execution environment with multiple, even conflicting, software requirements on the same shared infrastructure. It also provides full control of the life cycle of virtualized services management.

5.3. For System Integrators

It fits into any existing data center due to its open, flexible and extensible interfaces, architecture and components. It can build any type of cloud deployment. It is open sourced under Apache license and has seamless integration with any product and service in the virtualization/cloud ecosystem and management tool in the data center.

5.4. Usage in Industry

BIT is a business to business internet service provider in the Netherlands specialized in colocation and managed hosting. It has tested both OpenStack and OpenNebula in a lab environment where they found OpenNebula served them better than Openstack[8]. For more look into user testimonials on OpenNebula webpage[9].

6. KEY FEATURES AND COMPONENTS OPENNEBULA

6.1. Features

There are several key features of OpenNebula[10] for the comprehensive management of virtualized data centers to enable private, public and hybrid clouds. Some of these key features are

interfaces for cloud consumers, service management and catalog, interfaces for administrators and advanced users, appliance market place, chargeback, capacity and performance management, high availability and business continuity, virtual infrastructure management and orchestration, external cloud connector, platform independent, security, integration with third-party tools, fully open-sourced, automatic upgrade process, quality assurance and community support.

6.2. Components

OpenNebula has several advanced components[11] that can be easily integrated and deployed. Some of the important components that are extensively used are listed below:

1. Multi-VM Applications and Auto-scaling
2. Host and VM Availability
3. Data Center Federation
4. Cloud Bursting
5. Application Insight
6. Public Cloud
7. MarketPlace

7. DISADVANTAGES

There are also some drawbacks that needs attention before one choose to use OpenNebula. Some of them are Greater dependency on service providers, Risk of being locked into proprietary or vendor-recommended systems, Potential privacy and security risks of putting valuable data on someone else's system. Another important problem what happens if the supplier suddenly stops services. Even with this disadvantages the technology is still used greatly in various industries and many more are looking forward to move into cloud.

8. EDUCATIONAL MATERIAL

A great place to start is by reading the OpenNebula documentation[12]. Future Systems has a tutorial on their webpage[13] to get started with OpenNebula. Handbook of Research on High Performance and Cloud Computing in Scientific Research and Education[14] by Marijana Despotovic-Zrakic is a book to get started from the basics of cloud computing and understanding the working of OpenNebula.

9. CONCULSION

The OpenNebula's architecture and its integration to adapt to most infrastructures make OpenNebula's ability to handle public, private and hybrid clouds with ease. OpenNebula has reduced efforts for handling cloud services by reducing costs of infrastructure, increasing the utilization of available resources, increase the computing power by integrating different machines and simplifying the development and deployment in industry.

REFERENCES

[1] "Wikipedia-opennebula," webpage. [Online]. Available: https://en.wikipedia.org/wiki/OpenNebula

[2] "About-techonology," webpage. [Online]. Available: https://opennebula.org/about/technology/

[3] "Wikipedia-opennebula," webpage. [Online]. Available: http://blog.dsa-research.org/wp-content/uploads/2008/08/one_amazon1.png

[4] "Data center virtualization and solutions," webpage. [Online]. Available: https://opennebula.org/the-opennebula-engine-for-data-center-virtualization-and-cloud-solutions/

[5] "Opennebula system interfaces," webpage. [Online]. Available: http://docs.opennebula.org/5.2/integration/system_interfaces/index.html

[6] "Opennebula infrastructure integration," webpage. [Online]. Available: http://docs.opennebula.org/5.2/integration/infrastructure_integration/index.html

[7] "Opennebula ecosystem," webpage. [Online]. Available: https://opennebula.org/community/ecosystem/

[8] "Wikipedia-opennebula," webpage. [Online]. Available: https://opennebula.org/using-opennebula-at-bit/

[9] "Wikipedia-opennebula," webpage. [Online]. Available: https://opennebula.org/users/usertestimonials/

[10] "Key features of opennebula," webpage. [Online]. Available: https://opennebula.org/about/key-features/

[11] "Opennebula adavanced components," webpage. [Online]. Available: http://docs.opennebula.org/5.2/

[12] "Opennebula," Web Page. [Online]. Available: https://opennebula.org/documentation/

[13] FutureSystems, "Opennebula online tutorial," Web Page. [Online]. Available: https://portal.futuresystems.org/tutorials/opennebula

[14] M. Despotovic-Zrakic, V. Milutinovic, A. Belic, and I. Global, *Handbook of Research on High Performance and Cloud Computing in Scientific Research and Education*, ser. Advances in Systems Analysis, Software Engineering, and High Performance Computing. Hershey, Pennsylvania (701 E. Chocolate Avenue, Hershey, Pa., 17033, USA), 2014.