SIGMA Cloud

An Open Academic and Research Environment

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Keywords

SIGMA, cloud, SaaS, Opennebula

1. ABSTRACT

SIGMA, as many other entities had to face the situation of a datacenter full of servers, a high power consumption, heat diffusion… the migration of the CPD to a Virtual Datacenter was a matter of time, and the time came as so many servers required a large workforce to manage, a large amount of power to fed the servers and to cool the rooms, even the servers were sometimes underused and squandered.

SIGMA as a non-profit organization and a consortium of public Universities has a policy of support and foster open source organizations, and whenever possible implement open source over commercial solutions.

Looking for the solution that best fitted our needs was a hard work, primary due to the many projects that exists over the Internet, some solutions analyzed were Openstack, Proxmox and Opennebula, being the latter the chosen one.

That was our first step into the open cloud world.

2. SIGMA GESTION UNIVERSITARIA CONSORTIUM

SIGMA Gestion Universitaria [1] is a nonprofit consortium established in 1996 by a group of 8 top level Spanish Public Universities to provide technological solutions to their needs for managing academics, learning, research and organization processes. SIGMA represents 20% of the students in the Spanish university system. The consortium's objective has evolved towards the continuous technological modernization of university management through the development of IT solutions aimed at automating the administrative processes and, as a result, guaranteeing their effectiveness.

Technology and innovation are the backbone of the services and solutions provided, based on a highly open source development and deployment platform for J2EE5 certified application servers compliant on a multi-tier and high performance proven open architecture. Internationalization is also one of SIGMA's top priorities. For years, SIGMA has established relationships with other European universitity consortiums. Lately, SIGMA has open new strategic areas of interest such as SaaS, BI, eLearning and Mobile.

3. Introduction to Open Cloud

There are a lot of projects about cloud management, each one with its own strengths and weaknesses, the first task we faced was to define the main features we need and centered the search on the projects that best could fit those requirements. So to delimit the scope of the project we centered the decision over 3 projects, Openstack[2], Proxmox[3] and Opennebula[4].

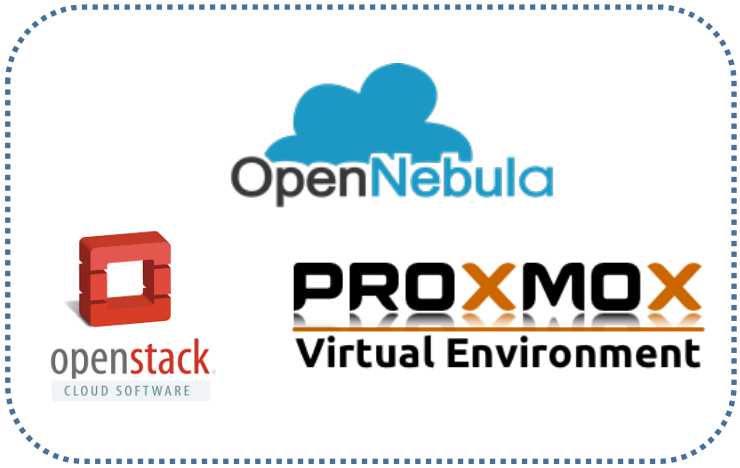

Figure 1. Cloud and Virtualization open projects

Openstack is a project with an installed base larger and an extended community, but digging in the requirements it ends to be an overkill project, it involves about 16 subprojects and implement it require a great investment in time and human resources, so for us it doesn't worth the benefits of the great features.

While evaluating Openstack, about three years ago, it was difficult to get all the environment functional, and even once the server was operative it was easy to notice that maintaining upgraded all the modules could be difficult, from the beginning it was clear that manage the cloud infrastructure will be a hard task very error prone.

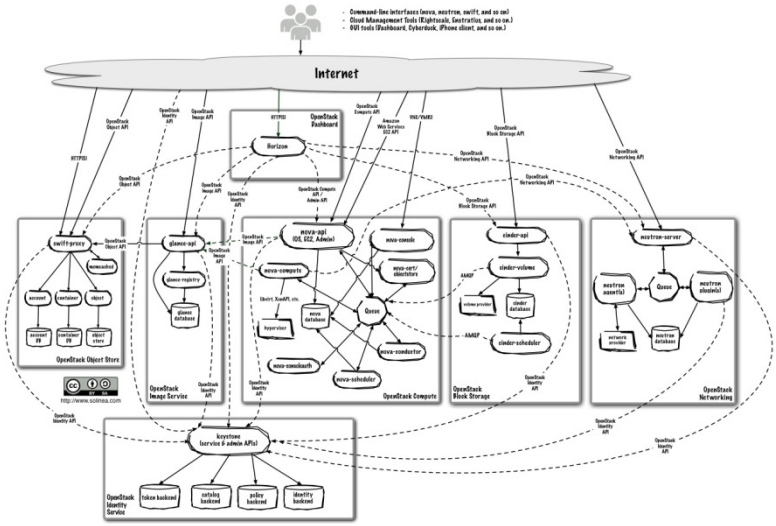

Figure 2. Opentack module interoperability

Proxmox is not really a cloud manager but a server virtualization management software, it could be a limitation to provide real cloud service to the community but as a first approach it could fit the requirements as it has a lot of interesting features integrated, as it manages full virtualization and linux containers, high availability, backups… all integrated in a central management console.

Finally we decided that it's worth to think in the long run and start building our own cloud.

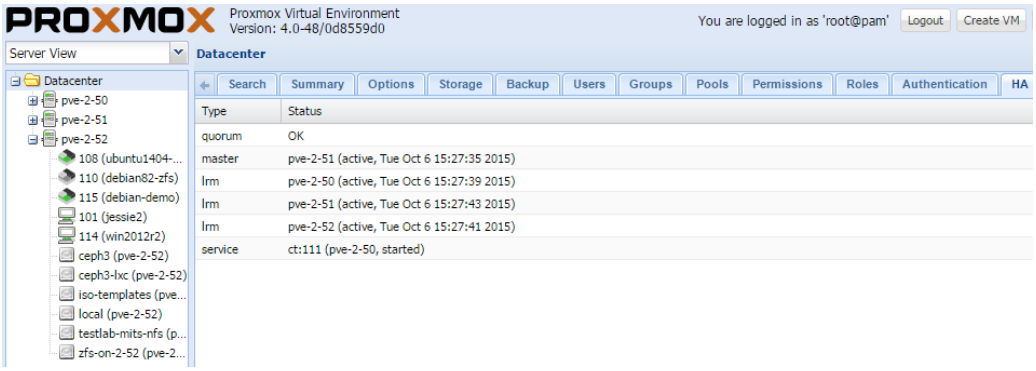

Figure 3. Proxmox console

Opennebula includes some key features that made the decision very easy:

- Fully open source
- Avoid vendor lock-in, platform independent
- Simple, is very easy to install and update
- Mature, since 2008 this project is growing driven by user needs
- Enterprise-class product
- Cloud Bursting, extension of private clouds with resources from remote clouds
- Multiple zones, centralized management of multiple instances for scalability and isolation
- Autoscaling, creation of application flows with auto-scaling policies based on performance metrics and schedule

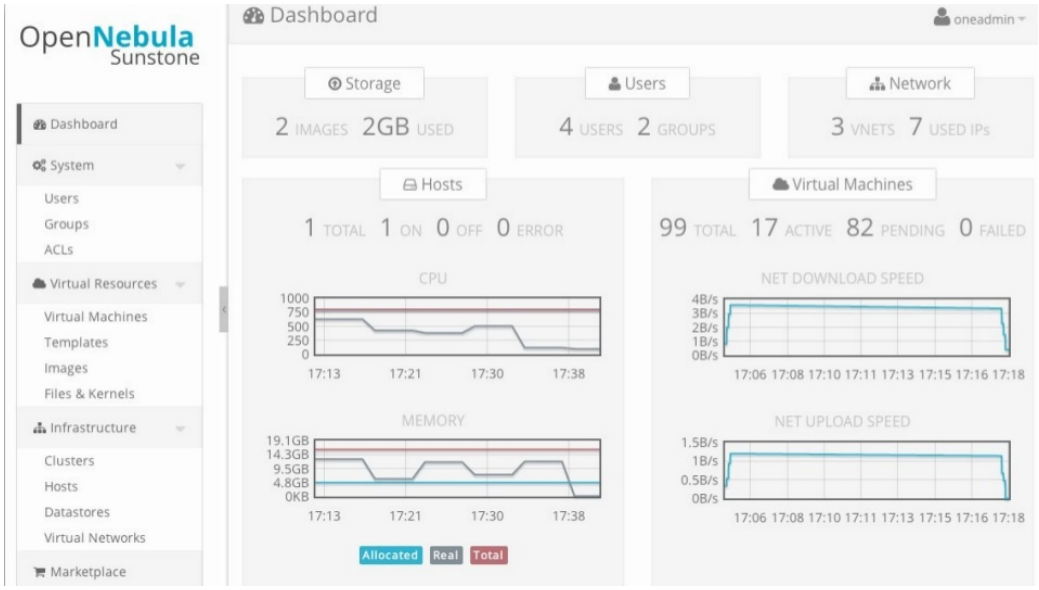

Figure 4. Opennebula GUI Sunstone - Dashboard

4. Architecture

The architecture provided by Opennebula allows us to scale out the SIGMA cloud adding more nodes whenever is needed and even in different geographical zones.

The basic parts are a frontend to centralize the management, a datastore as repository of images and virtual machines, and the worker nodes with the hypervisor:

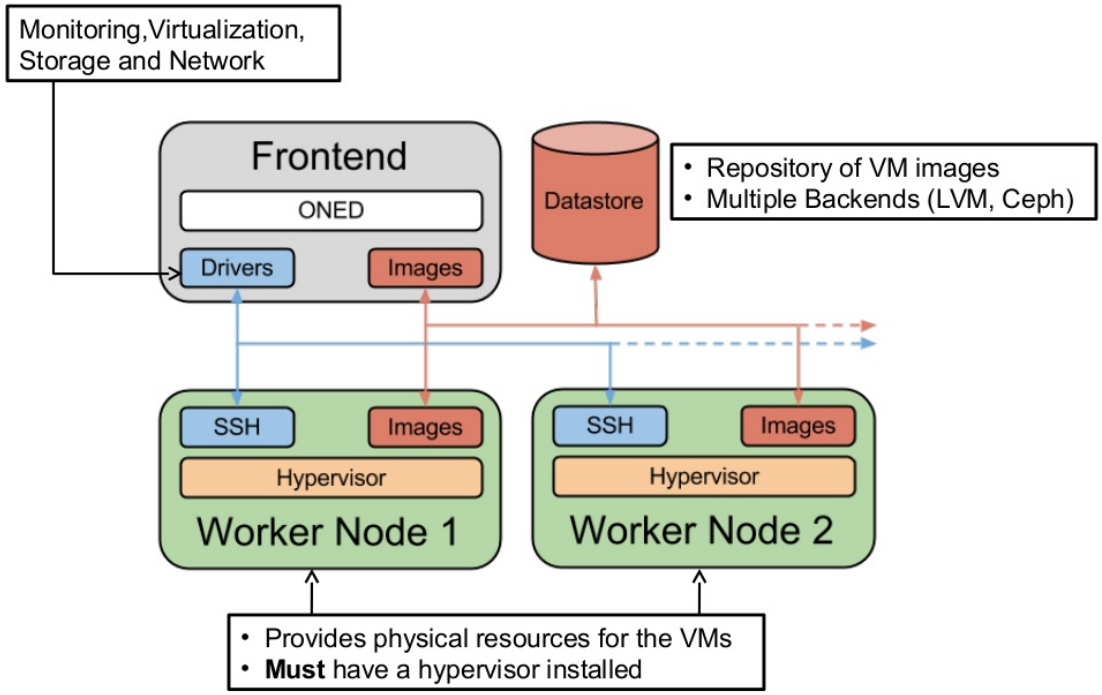

Figure 5. Opennebula Environment

As said before Opennebula is platform independent, so you can choose the hardware that best fits your needs, only requirements to use Linux.

In our case we chose CentOS as our distribution to implement the infrastructure as we have long experience with it. So the frontend and all the worker nodes are CentOS Linux.

To properly work and communicate is necessary the ssl key exchange between all the nodes, also the installation of the hypervisor chosen on each node. Our preference is KVM, we think it has the best performance in the platform we use, in the last versions it has improve performance and security.

Each node will provide the physical resources, memory and CPU, maybe also disk, but this will be conditional on the storage strategy. All this resources will be controlled from the frontend, it can be done in two ways, by command line or from the GUI frontend named Sunstone.

The storage strategy will define the possibility of use some feature or not, like a shared strategy will enable you to use live migration between different hosts without losing service.

From a more general point of view Opennebula offers an open and complete architecture that allows a great level of configuration and customization of our own cloud.

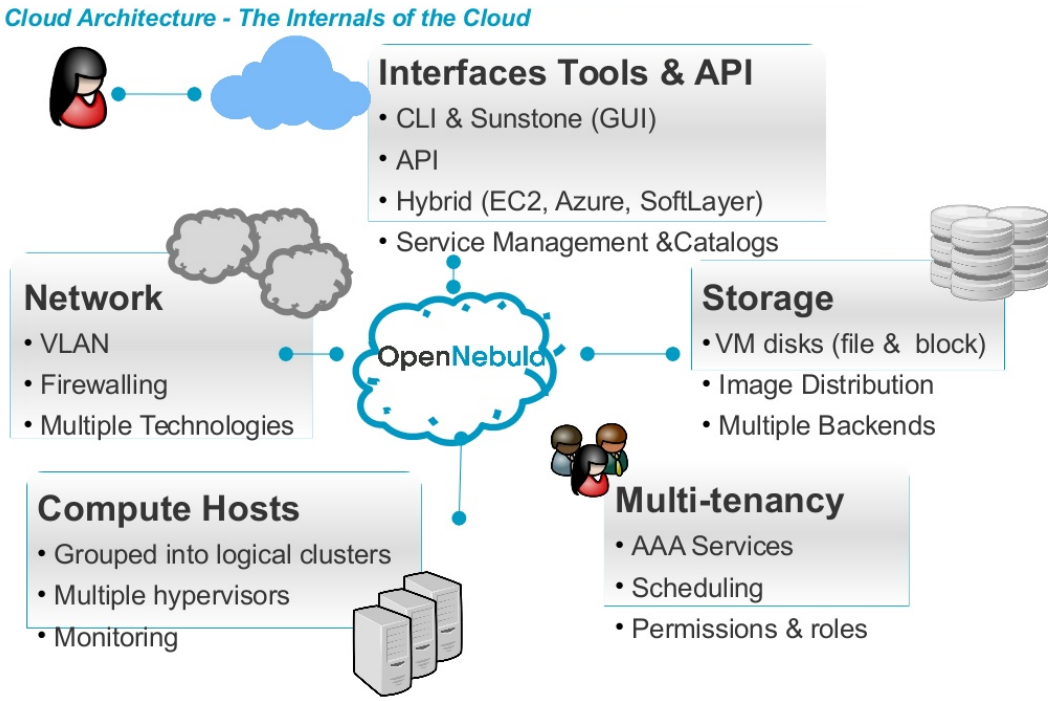

Figure 6. Opennebula Architecture

The API provided allows the private cloud to connect to some other public resources (cloud bursting), we can choose between different network technologies and strategies.

Multi-tenancy capacity enables us to provide isolated environments to different groups of users while sharing resources.

High Availability feature provides fault tolerance in front of hardware issues, in case of a server fault the working images are moved to other nodes.

A cloud Federation allows the ease of management of different geographical VCPD's by centralize the management and delegate administrative tasks in remote offices as shown in the next figure.

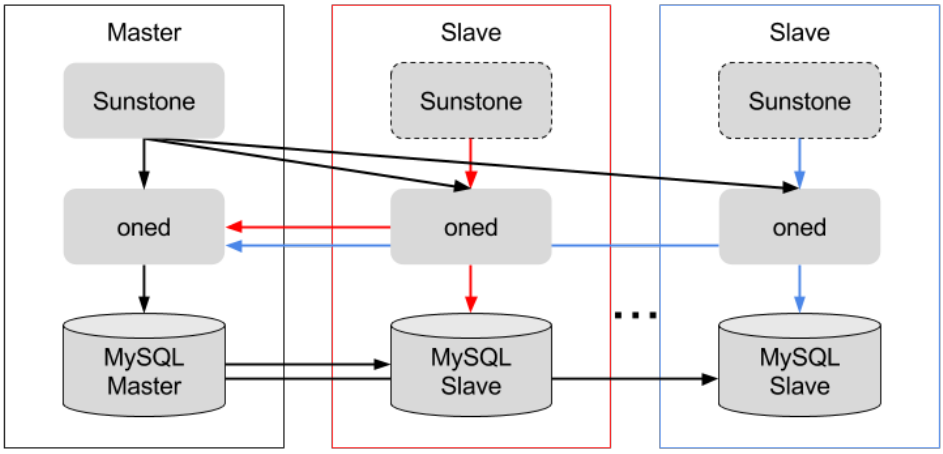

Figure 7. Opennebula federation schema

5. Conclusions

The implementation of an open cloud management infrastructure is a breakthrough that enables us to achieve new objectives, be more competitive and the possibility to offer to our community of partners and users a lot more services while adjusting the budget.

As our business grow we try to use high quality standards and follow international best practices, in this scenario building our own cloud was the more logical scenario to step into.

As many other institutions the great number of possibilities available in the current cloud landscape represents a challenge for us, is easy to take a bad choice, so we try to manage by evaluating, comparing and participating in the cloud community as much as we can.

Using Opennebula has helped us to build our own private cloud in a way that we were able to learn quick, implement fast a basic cloud infrastructure, which we're evolving and expanding, and keeping the budget.

In the next years we've planned to deploy an infrastructure over different geographical locations to expand the SIGMA Cloud ONE thanks to the base we have yet built and taking advantage of the numerous resources and key features we have available.

6. REFERENCES

[1] **SIGMA Helping Universities Succeed** http://www.gestionuniversitariasigma.com/

[2] **Openstack** http://www.openstack.org

[3] **Proxmox** http://www.proxmox.com

[4] **Opennebula** http://www.opennebula.org

AUTHORS' BIOGRAPHIES

Juan Jose Fuentes
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Technical Computer and Software Engineer at Universitat Autònoma de Barcelona (1998 - 2001). He works for SIGMA since 2001, currently leading the Middleware & Systems area. His role covers a wide range of activities from designing strategy plans for backups, recovery, monitoring and storage to defining and carrying out the design of the CPD provisioning. He maintains and upgrades the backend resources of SIGMA. He gives advice to the company customers in their hardware infrastructures. He took part in the strategic migrations projects such as database migration (Ingres to Oracle), and middleware migrations (Iplanet-Glassfish-Weblogic).
In the lasts year his main effort has been focused on achieving a multi-tenant solution in order to minimize the maintenance cost of the SaaS service that SIGMA delivers to their customers.
He is currently focused on building the SIGMA Higher Education SaaS in a cloud environment.

Jordi Cuní

He was born in 1976 in Barcelona Spain. Computer Science degree at Universitat Oberta de Catalunya (2006 – 2012), Computer and Software Engineer at Universitat Autònoma de Barcelona (1997 – 2000).

He works for SIGMA since 2000, being the current Manager of Architecture Area and Software quality assurance Area. He leads a development team counting on 7 people for those areas.

His role focuses mainly on maintenance and develop the own Sigma framework in order to increase the productivity, define the methodology among the different areas and establish the software development tools for the rest of the company. At last but not least his area takes part on technical and performance support for our customers and helps them in the migration projects of their back-end resources. Previously, he had been project management for developing SIGMA's area for 5 years. His main efforts was focused on develop software solutions on resource planning necessities, stock management of static and mobile resources and physical and on-line surveys.