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THEME:

"COMPARATIVE ANALYSIS SOFTWARE TO RAISE AN INFRASTRUCTURE AS A SERVICE IN CLOUD COMPUTING AND IMPLEMENTATION OF A PRIVATE CLOUD."

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COMPARATIVE ANALYSIS SOFTWARE TO RAISE AN INFRASTRUCTURE AS A SERVICE IN CLOUD COMPUTING AND IMPLEMENTATION OF A PRIVATE CLOUD.

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Spanish Summary. *Este proyecto tiene como objetivo establecer un modelo de infraestructura que sea fácil de gestionar, seguro en el manejo de datos, económicamente viable y que en un futuro pueda ser adoptado dentro de la Facultad de Ingeniería en Ciencias Aplicadas (FICA). Para esto se ha evaluado dos de las infraestructuras más usadas en el mercado, como son: OpenNebula y OpnStack, En la comparativa se determinaron métricas ponderadas y realizaron pruebas de ancho de banda y latencia, cuyos resultados indicaron que OpenStack es la infraestructura más conveniente para ser usada en la Facultad de Ingeniería en Ciencias Aplicadas de la Universidad Técnica del Norte.*

Palabras Claves

Abstract. *This Project has as objective establishes a model of infrastructure it is easy to manage, safe in the operation of data, economically viable and that in the future could be adopted inside of the Facultad de Ingeniería en Ciencias Aplicadas (FICA). For this it has been evaluated two of the most used infrastructures at the market, as they are: OpenNebula and OpenStack. At the comparative were determined weighted metrics and perform broadband and latency tests, whose results indicated that OpenStack is the most convenient infrastructure for been used at the Facultad of Ingeniería in Ciencias Aplicadas of the Universidad Técnica of Norte.*

Keywords

1. Introducción

North Technical University is currently managing a public cloud-based Office 365, which raises some concerns, which focus on data security, to be entire administration led by an external company, for that reason has less cost, availability, security and transparency of the platform will depend on the company that owns and parameters that may not have much control. Therefore this work provides alternatives for the University implemented a private cloud with free software which is administered directly by staff of the University.

With this research a valuable contribution to technology transfer and knowledge, aiming at more efficient satisfaction of basic needs and ensuring the quality of research conducted at the University will be held. Here general aspects of the topic will be discussed, as the study, types and main characteristics of infrastructure technologies Free Software as a Service for Cloud Computing.

As arises and is successful the following objectives:

a) **General objective:** *Select suitable software through the comparison of two infrastructure as a service cloud computing using Free Software.*

b)   Specific objectives
- *To study the characteristics of the Technology Infrastructure as a Service Free Software for Cloud Computing.*
- *Set the parameters to compare Infrastructure as a Service.*
- *Building test environments for comparative analysis of each of the Technology Infrastructure and Cloud Service for Private Cloud Computing, to select the best technology to suit the needs of the FICA-UTN.*
- *Implement a software infrastructure (IaaS) from the cloud with free software to the Engineering Faculty of Science Applied (FICA).*

2.   Materials and Methods

The study involved a comparison so it has conducted an investigation of the outstanding globally and within the infrastructure level which has been determined the most outstanding.

2.1 Establish technologies to compare

To determine which technology is the best of an Infrastructure as a Service (IaaS) free software for private clouds, you should perform a thorough analysis, taking into account certain criteria and parameters for comparison, which is to select the two technologies more used.

"Managing a cloud infrastructure it is provided by the suppliers of an Infrastructure as a Service (IaaS), through a payment made by users and obtain the services of a more scalable and resilient manner. The problem is how to manage and monitor cloud infrastructure. The concerns are; vendor lock, security, availability, etc. To overcome these problems, infrastructure poses a different management models to develop projects in the following sections". [1]

- *OpenNebula*
- *Papaya*
- *RESTful Cloud Management System (CMS)*

"There are several software tools for the implementation of an Infrastructure as a Service (IaaS), through which its own Infrastructure as a Service (IaaS) is creating among which the following": [2]

- *OpenNebula*
- *OpenStack*
- *Cloudstack*
- *Eucalyptus*

"Describes the platforms open source cloud management, have a common feature in this type of solutions are considered flexible and open tools that adapt to environments of existing data centers to build any implementation of Cloud Computing. Initially, as managers

of private clouds (own infrastructure) with the possibility of facing the construction of hybrid clouds (combination of private infrastructure and public infrastructure) offering highly flexible and scalable systems". [3]

Within this type of tools and after a thorough analysis, we highlight:

- *Eucalyptus (http://open.eucalyptus.org)*
- *OpenNebula (http://www.opennebula.org).*

With respect to the analysis by technological researchers report that in recent years the free software tools for Infrastructure as a Service (IaaS), so we have taken as reference the most widely used software and with the help of Google Trends which is a Google Labs tool which shows the most popular search terms in the recent past.

Figure 1 compares the search based on keywords and in recent years, which will result in determining a choice of free software tools for determining compare 2.
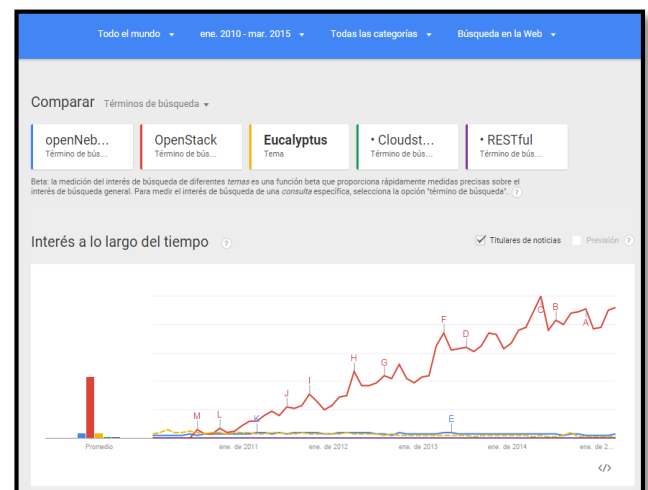

Figure. 1: *Comparison of the outstanding Iaas.*

Within this analysis we can see that the tools used worldwide: OpenStack first place, followed by OpenNebula, being these infrastructures to compare.

2.2 Analysis of selected Infrastructure as a Service.

From the data obtained previously determined 2 OpenStack and OpenNebula infrastructure, these being open source tools that are currently used by small businesses, large institutions around the world.

Why the characteristics of the 2 infrastructures described:

- *OpenStack*
- *OpenNebula*

2.3 OpenStack

"OpenStack is a set of free software projects that can be used together to operate a network infrastructure to provide cloud IaaS.

The OpenStack project is a combination of three main components:

a. *OpenStack Compute (Nova) is used to organize, manage and provide virtual machines with many hypervisors, including KVM and QEMU.*

b. *OpenStack Object Storage (Swift): provides redundant storage for static objects, this service is scalable to massive data sizes and can theoretically provide infinite storage.*

c. *OpenStack Image Service (Glance): provides storage for virtual disks kernel and images, is able to accept images in many formats, including the popular Amazon Machine Image (AMI), Amazon Kernel image (AKI) and Amazon Ramdisk image (ARI)". [4]*

2.4 OpenNebula

"OpenNebula is the industry standard for virtualization open source data center, providing a simple but substantial infrastructure that has multiple features with a flexible solution for building and managing enterprise cloud and virtualized data centers, OpenNebula offers many interfacesThey can be used to interact with the functionality offered to manage physical and virtual resources". [5]

There are four main different perspectives to interact with OpenNebula:

• *Interfaces cloud to cloud consumers, such as query interfaces EC2, EBS and a simple Sunstone OCCI.*
• *Management interfaces for advanced cloud users and operators, as a command line interface and the powerful Unix GUI Sunstone.*
• *Extensible country of low cloud integrators for Ruby, Java and XMLRPC API.*

As OpenNebula establishes a definition of open source software, which allows to control and manage different virtual machines in an established cloud, also offers flexibility allowing operate on different networks, storage units or hypervisors, this infrastructure can create a cloud quickly, whether public, private or hybrid level.

2.5 CentOS operating system

"CentOS is a Linux distribution business class derived from sources freely provided to the public, CentOS (Community Enterprise Operating System) is a binary clone Linux distribution Red Hat Enterprise Linux RHEL, compiled by volunteers from the source code released by Red Hat. Is open source RHEL, CentOS is Free Software.

Reconstructs the volunteer community updates, trial deliveries and provide help". [6]

2.6 OpenStack operating system

"OpenStack Compute, offering computing power across virtual machines and network management.

OpenStack Object Storage, a software for redundant, scalable object storage capacity". [7]

2.7 Ubuntu Operating System

"Ubuntu is an operating system based on Linux and distributed as free software, which includes its own desktop environment called Unity. Its name comes from the eponymous ethics, in which we talk about the existence of oneself and cooperation of others. It is user-oriented novel and average, with a strong focus on usability and improving user experience. It consists of multiple software normally distributed under a free license or open source". [8]

2.8 Private Cloud

The type of cloud that is chosen is a private cloud because of the resources offered by the University, a private cloud, many benefits of public cloud services including self-service, scalability, elasticity and safety information is obtained.

2.9 Test modules OpenNebula

2.9.1. Architecture OpenNebula

OpenNebula build the infrastructure allows any type of cloud: private, public and hybrid. It has been designed to be integrated with any type of network and storage, thus adapt to existing data centers. Below it is shown as its design in a public cloud.
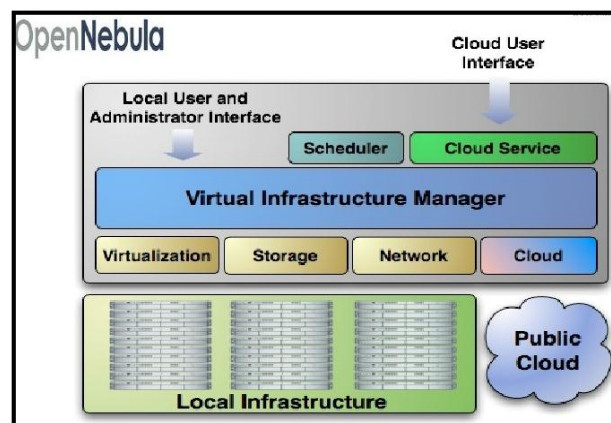

Figure. 2: *Designing the architecture of OpenNebula.*

2.9.1.2. Requirements for installing ESXi 5.0+

- *First you must download and convert the image with vmkfstools (vmkfstools -i vmdk source {target}} {vmdk).*
- *On the PC where it will 512 MB of free RAM is needed to install the Virtual Machine.*
- *• 10 GB of free disk space.*
- *For Virtual Infrastructure Client (VI Client).*
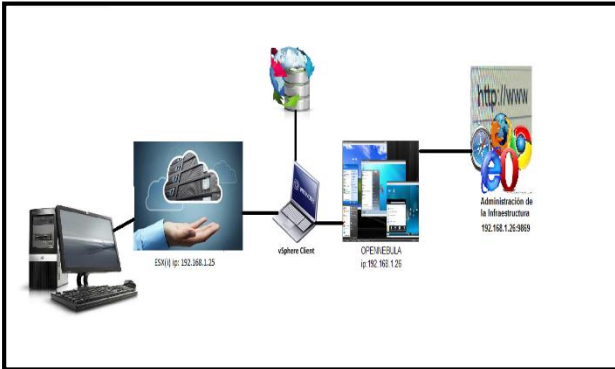- *Windows application to interact with the ESX server.*

Figure. 3: *Designing the architecture of OpenNebula specifying in detail the structure.*

2.9.1.3. Description of the steps for installing the Infrastructure as a service OpenNebula.

Due to high capacity requirements needed for the implementation of infrastructure it is necessary to have two computers with excellent features.

Infrastructure as a service OpenNebula is a free software where infrastructure components are in the official website and can be downloaded free. Once you downloaded the elements of infrastructure installation proceeds with the following steps:

a) *Installing VMware Workstation which need an activation key and the installer is free.*

b) *In this software we proceed to create a virtual machine on which the ESXi is stored (hypervisor which allows virtualize and run multiple operating systems simultaneously). The hypervisor you configure an IP address according to the physical machine, customer and infrastructure and being in the same VLAN.*

c) *VMware vSphere Client is running (VMware vSphere Client is a leading virtualization platform in your field that serves to build cloud infrastructures). To connect with ESXi, the IP address configured on the ESXi user and password which then proceed to the installation of infrastructure as a service (IaaS) OpenNebula is entered. When making the connection must verify the ESXi is properly connected to the physical machine using ping otherwise it will not engage.*

d) *Connect properly with the client allowed to proceed to the installation of OpenNebula which was downloaded from the official website, the image is installed taking into account the requirements for the infrastructure to operate properly, the OpenNebula-sandbox image is a virtual machine under centos which brings pre-configured and ready OpenNebula is to run virtual machines.*

e) *Is input to the console where IP address is configured according to the VLAN is established.*

f) *The system OpenNebula Sunstone which is a hub for easily managing the resources of the infrastructure and operations on it is entered as oneadmin where you enter the administrator Sunstone, which has more options You access the other views Sunstone for a regular users. To access Sunstone open in the browser at http: // ip << >>: 9869*

g) *When handling the view can manage users, virtual machines, data storage, system review, capacity availability, etc.*

2.9.2. OpenStack architecture

Infrastructure as a service allows OpenStack be implemented in a private cloud this being ideal for accelerating innovation, managing a large amount of storage and computing needs, ensuring data security.

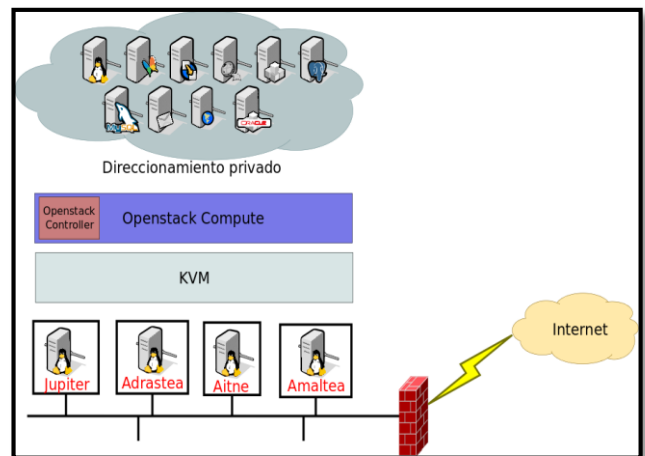**Figure. 4:** *Designing the architecture of OpenStack specifying in detail the structure.*

2.9.2.1. Software Requirements

☐ *A minimum of 8 GB of physical RAM.*

☐ *Systems must have 100 to 200 GB of storage for images ZFS VM instances and instantiation of VM.*

OpenStack Infrastructure as a service is an open source solution. That is intended to provide a flexible solution for both public and private clouds.

2.9.2.2. Description of the steps for installing the Infrastructure as a service OpenNebula

There is still little information so it is a technological issue but it has been successfully implemented as follows:

a) *Due to the high infrastructure characteristics required and this machine does not possess the necessary arrangements they were made to access the server partition the School of Engineering in Computer Systems.*

b) *The server encounters Centos in which a virtual machine is created with Ubuntu feel this free software.*

c) *In the Ubuntu virtual machine proceeds to the installation of GIT is a requirement to download the OpenStack Infrastructure as a Service.*

d) *Clone OpenStack where he joined the devstack folder is where the files for installing OpenStack is, some code is changed directions and routes etc..*

e) *Subsequently running OpenStack Infrastructure.*

f) *Access is done by placing the ip route amending adreess with console mode, the link with the route running is how we in sight.*

g) *The interface is designed with python which shows the components of the infrastructure, management is easy and clearly shows its elements as is information available host, computing services, storage blocks etc.*

h) *You can create instances audit performance operating system that comes by default is Cirrus light is an image under Linux but can be added later different operating system you want.*

2.10 Methods of comparative

Methodology comparison of technical and economic offers, as the first point software requirements and hardware arises, there are several similar parameters found between the infrastructure, which are assigned a prefix and get variables, which we take to get a proposal positive, so we can make a conclusion.

Technical offers →T1

Economic offers →E1

To determine the total percentage in the transposed matrix raised for comparison the following formula is established:

$$\frac{(\sum PT * 100\%)}{\sum TPT} = 100\% \quad (1)$$

The explanation of the formula is then performed.
PT= *Technical Parameters*
TPT= *Total technical parameters*

The sum of the technical parameters indicates the total amount of "1" which multiplied by 100% determines a value which is divided by the sum of the technical parameters so you get a total percentage.

NOTE: *This formula is also applied to financial offers E1.*

Once obtained the total percentage raises the following formula:

$$\% * VAP = PP \quad (2)$$

The explanation of the formula is then performed.
VAP= *Value Assigned to the Proposal*
PP= *Points of the Proposal*

NOTE: *This formula is also applied to financial offers E1.*

Already obtained the score of both technical and economic proposal it proposes the following formula:

$$\frac{(PGET * PGEE)}{PE} = PTP \quad (3)$$

The explanation of the formula is then performed.
PGET= *Global Technical Evaluation Score*
PGEE= *Global Economic Assessment score*
PTP= *Total score of Proposal*

Getting the best evaluated bid and technical and economic parameters.

3.Results

3.1. Methodology comparison of technical bids and economic

Comparison methodology which features exposed both technical and economic protruding in each of the infrastructure, software and hardware requirements are raised to stand out in Table 1 arises.

In relation to the evaluation of economic parameters Table 4 similarly shows the rating of each infrastructure costs. With the percentage obtained in Table 6 is multiplied by a value that is assigned regardless of the percentage obtained, which gives a score for each proposal.

Alternativa o Propuesta	%	Valor asignado a la propuesta (0 a 100)	Puntaje de la Propuesta		%	Valor asignado a la propuesta (0 a 100)	Puntaje de la Propuesta
Costos de licencias	50,00%	50	25,0		50,00%	100	50,0
Costos de soporte	16,67%	90	15,0		16,67%	90	15,0
Costos de implementacion	33,33%	50	16,7		33,33%	80	26,7
Costo de soporte técnico presencial	0,00%	50	0,0		0,00%	60	0,0
			56,7				91,7

Table 4: *Evaluation of Economic Parameters*

Table 5 gives a final grade evaluating the results of the above scenarios, giving as well as a total score of the proposal, conducting a sum by the total score of the technical evaluation and overall score of economic evaluation that it is divided by the number of proposals, thus achieving a total.

PROPUESTAS	Propuesta Económica	Puntaje Global Evaluación Técnica (PT)	Puntaje Global Evaluación Económica (PE)	Puntaje Total de la Propuesta (PTP)
OPENNEBULA	2	80,9	56,7	68,7948718
OPENSTACK	2	87,4	91,7	89,525641

Table 5: *Final grade for proposals.*

Note: *proposal* **#2** *as the most suitable is determined as its total score is the highest* **89,525641**

3.2. Measuring latency and bandwidth

As regards the measurement of latency raised the same scenario with the same parameters and the same provider from a different segment, for real results getting the following results:
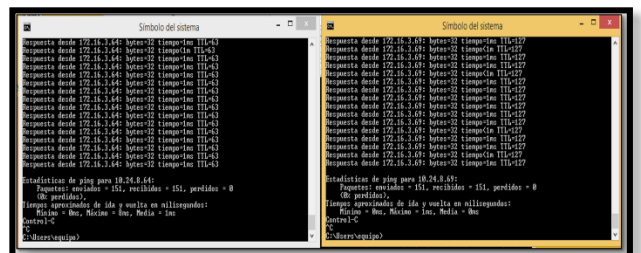

Figure. 5: *latency between OpenStack vs OpenNebula.*

3.3. Bandwidth infrastructure

- **Bandwidth OpenStack**

To measure the bandwidth one JPerf Java-based application is required, which can be used on any operating system that has a Java interpreter. It is very simple to use and allows a simple way to measure the speed between two computers that are on a network, and display the results graphically.
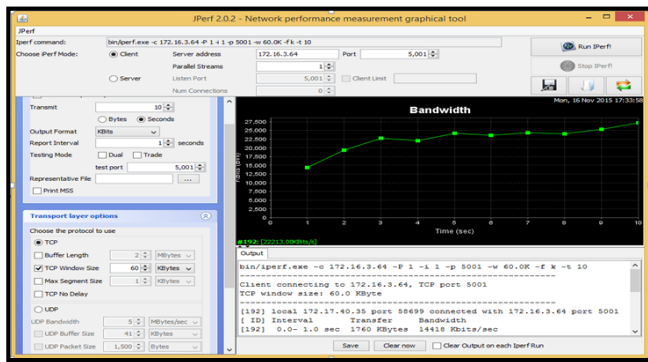

METODOLOGÍA DE COMPARACIÓN DE OFERTAS TÉCNICAS Y ECONÓMICAS		
Parámetros Técnicos	**Requerimientos de software y hardware**	
	Información disponible	T1
	Facilidad de implementación	T2
	Compatibilidad	T3
	Preparación/producción	T4
	Soporta control de acceso basado en roles / seguridad	T5
	Software libre	T6
	Latencia	T7
	Requerimiento de memoria RAM	T8
	Requerimiento del procesador	T9
	Requerimiento de espacio en el disco	T10
	Interfaz de usuario	T11
	Aplicaciones	T12
	Interfaces	T13
	Capacidad de Gestión	T14
	Despliegue Nube	T15
	Capacidades de la empresa	T16
	Integración *Datacenter*	T17
METODOLOGÍA DE COMPARACIÓN DE OFERTAS TÉCNICAS Y ECONÓMICAS		
Parámetros Económicos	**Costos**	
	Costos de licencias	E1
	Costos de soporte	E2
	Costos de implementación	E3
	Costo de soporte técnico presencial	E4

Table 1: *Determination of technical and economic parameters.*

Table 2 shows the comparative technical and economic offers for each of the parameters set out above, these parameters are compared by giving importance and value 1 to the most important parameter thus becoming a transposed matrix, the values "1" are he added that total a percentage which pulls your result will be 100%.

METODOLOGÍA DE COMPARACIÓN DE OFERTAS TÉCNICAS Y ECONÓMICAS																				
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	TOTAL	%
Información disponible	T1	X	1	1	1	1	0	1	0	0	0	1	1	1	1	1	1	1	12	9,23%
Facilidad de implementación	T2	0	X	X	1	0	X	1	0	0	0	0	0	0	0	0	0	1	3	2,31%
Compatibilidad	T3	0	X	X	X	1	0	1	0	0	0	0	1	1	0	0	0	1	4	3,08%
Preparación/producción	T4	0	0	X	X	1	0	1	0	0	0	0	1	1	0	0	0	1	5	3,85%
Soporta control de acceso basado en roles / seguridad	T5	0	1	0	0	X	0	1	0	0	0	0	1	1	1	1	1	0	7	5,38%
Software libre	T6	1	X	1	1	1	X	1	1	1	1	1	1	1	1	1	1	1	14	10,77%
Latencia	T7	0	0	0	0	0	0	X	0	0	0	0	0	0	0	0	0	0	0	0,00%
Requerimiento de memoria RAM	T8	1	1	1	1	1	0	1	X	1	1	1	1	1	1	1	1	1	14	10,77%
Requerimiento del procesador	T9	1	1	1	1	1	0	1	0	X	1	1	1	1	1	1	1	1	13	10,00%
Requerimiento de espacio en el disco	T10	1	1	1	1	1	0	1	0	0	X	1	1	1	1	1	1	1	12	9,23%
Interfaz de usuario	T11	0	1	1	1	1	0	1	0	0	0	X	1	1	1	1	1	1	10	7,69%
Aplicaciones	T12	0	0	0	0	0	0	1	0	0	0	1	X	1	0	0	0	0	3	2,31%
Interfaces	T13	0	0	0	0	0	0	1	0	0	0	0	0	X	0	0	0	1	2	1,54%
Capacidad de Gestión	T14	0	1	1	1	0	0	1	0	0	0	1	1	X	0	1	1	8	6,15%
Despliegue Nube	T15	0	1	1	1	0	0	1	0	0	0	1	1	1	X	0	1	7	5,38%
Capacidades de la empresa	T16	0	1	1	1	0	0	1	0	0	0	1	1	0	1	X	1	8	6,15%
Integración Datacenter	T17	1	1	1	1	0	0	1	0	0	0	1	1	0	1	0	1	X	8	6,15%
																			130	100%

		E1	E2	E3	E4	Total	%
Costos de licencias	E1	X	1	1	1	3	50,00%
Costos de soporte	E2	0	X	0	1	1	16,67%
Costos de implementacion	E3	0	1	X	1	2	33,33%
Costo de soporte técnico presencial	E4	0	0	0	X	0	0,00%
						6	100%

Table 2: *Evaluation Methodology*

Table 3 shows a rating of technical and economic parameters of each infrastructure is performed. With the percentage obtained in Table 6 is multiplied by a value that is assigned regardless of the percentage obtained, which gives a score for each proposal.

Calificación de parámetros técnicos OPENNEBULA				OPENSTACK		
Alternativa o Propuesta	**%**	**Valor asignado a la propuesta (0 a 100)**	**Puntaje de la Propuesta**	**%**	**Valor asignado a la propuesta (0 a 100)**	**Puntaje de la Propuesta**
Software libre	10,77%	90	9,7	10,77%	100	10,8
Requerimiento de memoria RAM	10,77%	60	6,5	10,77%	100	10,8
Requerimiento del procesador	10,77%	90	9,7	10,77%	80	8,6
Información disponible	10,00%	90	9,0	10,00%	50	5,0
Requerimiento de espacio en el disco	9,23%	70	6,5	9,23%	80	7,4
Interfaz de usuario	9,23%	70	6,5	9,23%	50	4,6
Capacidad de Gestión	7,69%	80	6,2	7,69%	80	6,2
Capacidades de la empresa	6,15%	50	3,1	6,15%	100	6,2
Integración Datacenter	6,15%	50	3,1	6,15%	50	3,1
Soporta control de acceso basado en roles / seguridad	6,15%	90	5,5	6,15%	100	6,2
Despliegue de Nube	5,38%	100	5,4	5,38%	80	4,3
Preparación/producción	5,38%	80	4,3	5,38%	100	5,4
Compatibilidad	3,85%	50	1,9	3,85%	100	3,8
Facilidad de implementación	3,08%	30	0,9	3,08%	60	1,8
Aplicaciones	2,31%	30	0,7	2,31%	50	1,2
Interfaces	2,31%	50	1,2	2,31%	60	1,4
Latencia	1,54%	60	0,9	1,54%	50	0,8
			80,9			87,4

Table 3: *Evaluation of Technical Parameters*

Figure. 6: *Bandwidth OpenStack*

- **Bandwidth OpenNebula**

OpenNebula the same application for which is shown in the chart at the beginning is used high and starts running down close to other infrastructure.
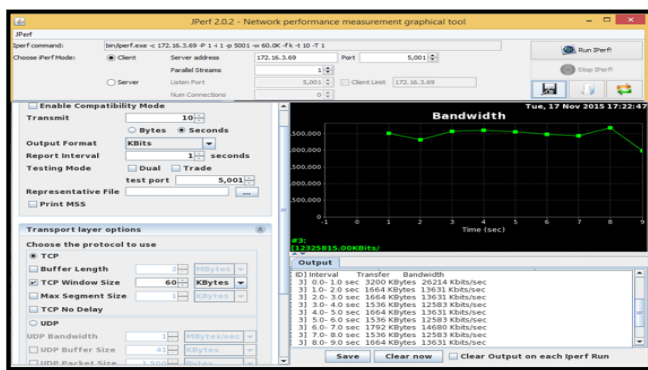

Figure. 7: *Bandwidth OpenNebula*

4. Conclusions

Upon completion of the comparative analysis of the Infrastructure as a Service to the following conclusions:

1. It was possible to determine the best open source infrastructure through a comparative analysis and install all its components on the server of the School of Computer Systems Engineering.
2. It has been proposed alternatives clearly to those institutions and companies that wish to migrate to this technology clearing doubts with regards to its implementation.
3. After completing the analysis of technical and economic metrics it can be concluded that the best data infrastructure with open source OpenStack.
4. The study is of vital importance in our environment for analysis before raising an Infrastructure as a Service, this being a guide in terms of facilities and licenses.
5. Several test scenarios which were subsequently evaluated to determine which arises infrastructure is the best, within these technical and economic parameters were measured.

6. With relevance to the implementation you can expose you have to have a vision or experience what is virtualization and basics, this being a basis for analyzing the requirements of hardware and software infrastructure required to lift.
7. Cloud computing is a vast field to be a new model for managing Information Technology (IT) based on reducing costs, optimize resources and within the institution / company.
8. Our country does not have clear legal framework that must be met for the implementation of these infrastructures in public and private entities, so there is still a lack of technological services and open source offering these facilities.
9. At the Technical University of the North, as in most institutions and companies around the world, without having planned already use cloud computing with various applications that exist on the internet such as Google Drive, Dropbox, yammer, slideshare etc. Since this is a step that goes towards the implementation of an Infrastructure as a private service. Virtualization, standardization and consolidation of this there will save resources.

Thank

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