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TEMA

COMUNICACIONES UNIFICADAS EN EL CLOUD PARA LA UTN

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Unified Communications in the cloud to the UTN

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Abstract. *The present study identify alternative Unified Communications, based on free software, determining necessary guidelines for the design of a Unified Communications system, thus ensuring communication in the institution and demonstrating a hosted in the cloud can provide equally good performance and availability of their services.*

During the development of the project, an investigation of platforms in the Cloud made, services offered by unified communications, signaling protocols, codecs audio and video, servers for unified communications, softphones for video conferencing and software for instant messaging, taking into account the compatibility and availability on mobile devices and PCs.

A comparative analysis of various platforms of Unified Communications such us Elastix, Cisco and Avaya were made, In the same way it was done with cloud computing platforms like OpenStack, Eucalyptus and OpenNebula.

The current status of the data network of the University was studied, in order to determine whether the characteristics and resources can support unified communications services, as well as it was dimensioned the resources each service demands, in terms of bandwidth and users, and a plan of extensions and users for Unified Communications services was created

Keywords

Cloud Computing, Unified Communications, plataforms, Open Stack, instant messaging, e-mail, Videoconference.

1. Introduction

The Technical University of the North has a main campus and some places nearby annexs to the same, within which they operate 6 faculties, various units and departments with a large number of persons who form part of the human talent which hinders communications within and outside the campus. Account with a data network deployed toward all campuses, which provides various services. By what you want between all the campus and its extensions have permanent communication, so that when you send a message or notification this for deployment to all devices that handle the user, guaranteeing the delivery of the same and optimizing the resources that you have.

With regard to concepts of unified communications, it is necessary to obtain information about their functionality and the way in which will be integrated services, in the same way with cloud computing, investigate job mode, the interactivity with the user and the availability of the services that are hosted in the cloud. To take the decision that software is to be used both for the communication server as for the accommodation of the services in the cloud, there will be a comparative analysis of the Amazon, OpenStack platforms, in the case of cloud and Elastix and Solutions for Cisco Unified Communications, based on standard analysis of requirements for software development ISO IEC IEEE 29148, analyzing certain factors and features such as system requirements, security, reliability of information, activities and processes, goals and objectives, integration of services and infrastructure support and limitations.

Once it have the clear definitions and concepts of the role, applicability of both unified communications as of cloud computing, as well as the software for each application, will prepare a design of how it will be structured the communications architecture taking into account the services that will integrate, as are: video conferencing, instant messaging, email. You will implement the design of the architecture with the video conferencing services, mail, instant messaging, and in the same way the platform integration and unified communications server hosted in the cloud, guaranteeing the availability, quality of service, scalability maintainability, optimization of resources and independence.

Unified Communications lead the convergence beyond the IP telephony, integrating presence, instant messaging, unified messaging, Web conferencing and video conferencing, on a common platform accessible from any media. Its advantages are evident in terms of increased productivity and faster decision making. The Unified Communications implementation in the UTN seeks to integrate existing solutions of communication with new solutions available, taking advantage to turn cloud computing platforms. The focus of the project is aimed at providing the services of Unified Communications in the cloud, so that deployed within and outside the campus.

2. Current situation of the university network and infrastructure design

Once you have reviewed the current status of the wireless network of the University were able to determine the necessary requirements for the design of the unified communications project, which are listed below:

- That the network and its teams cover most of the facilities within and outside the University to avoid inconveniences in the transmission of data.
- Bandwidth Control
- Management of Services.
- Control of latency, delay
- Allow the empowerment of ports that require applications
- There is a large number of servers that offer different services to the client and generates traffic on the network so that it is considered necessary to devise techniques of prioritization of traffic to ensure the voice service and data.
- It is advisable to maintain a level of low percentage in regard to packet loss and avoid network congestion.

2.1 PLATFORM REQUIREMENTS

SOFTWARE REQUIREMENTS

- The software must be free or open source, it must also be a trusted version, stable and that is not in evidence-gathering stage.
- The system must be scalable to higher versions.
- Count with documents, magazines, articles, etc. on the part of the developers.
- Must support audio codec and video as well as SIP extensions and IAX
- Management of the system either via http locally and remotely, have security mechanisms in what refers to the ssh access.

Requirements of Services

- It also considers the use of softphones in the personal computers of multiple users and if necessary on their Blackberry Smartphones, so that they can access both to their email accounts, Messaging or make a video.
- Reduce the problems of failures

Users Requirements

- Be able to access all the services are already so internally between users on the network and external as are the different units attached to the University.
- The services require user mobility in a transparent way, quick and without any disruption of the same.
- Have a good quality and videoconferencing, as well as ensure the delivery of packages both of the messaging and email.
- The communication must be acceptable and does not cause discomfort to the user.
- The server must be flexible to increase, change or delete users, accounts, etc.
- Security is required in the integrity of the information in the records of the users.
- Availability of service when the customer requires it.

2.2 SIZING OF COMPONENTS AND SERVICES

You must take into account the following aspects:

- Number of extensions that are to be connected to the central, in the case of video call with softphones.
- The number of videoconferencing through the softphone which aims to offer
- The type of codec to be used, both audio and video
- Emails accounts and dimensioning of users.
- Number of users interacting in the case of instant messaging, as well as the transfer of files
- Bandwidth for a video call VoIP

- It is important to take into account a significant aspect, if you have a platform on which you intend to install Elastix is must make performance tests with the items mentioned above.
- The management and administration of Elastix is done by web access for ease in its graphical interface.

2.3 SIZING OF THE UNIFIED COMMUNICATIONS SERVICE

For the dimensioning of the system is to take into account certain parameters that will serve for the design of the system, the lists below:

Capacity of the instance in the Cloud Platform

The characteristics of the instance that were assign to accommodate the Unified Communications Server are:

- 1GB RAM Memory
- 10 GB Hard Disk
- 2-core processor

These features will allow testing to measure the performance of the server and cloud platform, when testing with a small group of users, these features are sufficient in the case of instant messaging and email, because they do not have greater consumption of bandwidth, where this is not the same with videoconferencing, since it consumes about 1 Mbps per session, taking into account that the video is not of such high quality, which means that simultaneous video calls may be made but a limited number, this has to do with the audio and video codec you are using.

In so far as it related to the number of users, extensions and mail accounts, will be compared with a real server, in which the values of number of users ranges between 500 and 1000 users.

Voice Bandwidth

TABLE I

Audio Códecs

CODEC	Transmission Speed(kbps)	Voice payload size(payload) (bytes)	Voice payload size(payload) (MS)	Packets per second (PPS)
G.711	64	160	20	50
G.729	8	20	20	50
GSM	13	33	20	50

To perform the calculations of the bandwidth is going to use the gsm codec, since it is the one that shows have the best features for this design, due to having a compression of 13 Kbit/s respectively, offers a good performance with respect to the use of the CPU and is also enabled in Elastix, and making comparison with other codecs your bandwidth consumption is less, another audio codec is the G.729, but this codec requires the acquisition of license.

In the case of video conference is going to use the codec h.264 since it significantly increases the quality of the image with a technique for the valuation of the movement of the half-pixel, in addition it should be emphasized that the softphones support the codec h.264 , is the case of Jitsi (in the case of PCs) and Voip by Antisip(in the case of mobile devices), since that within the parameters of the videoconferencing is the mobility and the version of Voip by Antisip is most appropriate in mobile devices. You can also use softphones Zoiper and X-lite if the communication is 1:1, it should be stressed that these handle h.263 which is available in the same way in Elastix, only that significantly increases the jitter and echo when they bind more people to the conference

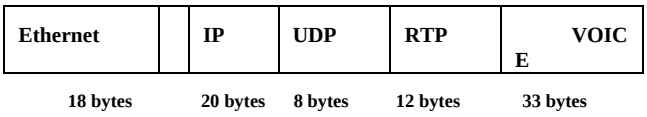


Figure 1. VoIP Frame Format

Total package size *= (link layer header) + (IP header/UDP/RTP) + (size of the payload of voice).*

= (18+20+8+12+33)

= 91 bytes

***PPS* (number of packages *tx*/*seg*)** = (*transmission rate codec*)/ (*payload*)

= (13 kbps)/ (33x8)

= (13000)/ (264)

$= 50\ pps$

Bandwidth$= (total\ package\ size) * (PPS)$

$= (91x8)*(50)$

$= (728)*(50) = 36400\ bps$

$= 36\ Kbps$

Video Bandwidth

Table II

H.264 video codec

Video codec	Resolution	Maximum load speed of ideo (kbps)	Minimum loading speed of ideo (kbps)
H.264	1280x720	250	15

***AB*=** 1000 Kbps

***Resolution*=** 1280x720

***Fps*=** 30

In this case select a minimum bandwidth, since making a comparison with the actual values that requires a conference, at least we should have a bandwidth of 3 Mbps. In this case was used a calculator bandwidth for video, in which entering values similar to the requirements were obtained an estimated bandwidth needed to have quality in the videoconference.

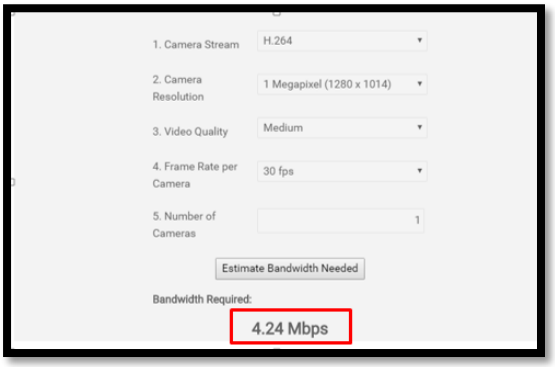


Figure 2. Bandwidth calculator for video

Audio Bandwidth: 36 Kbps

Video Bandwidth: 1 Mbps = 1000 Kbps

N. userss: 22

Total Bandwidth = 1036 Kbps x 22

Bandwidth = 22792 Kbps = 22 Mbps

Traffic Flow

A = Amount of video calls in one hour * duration of each call

Capacity of the email

To have a sample of 22 users, you can calculate the capacity of the e-mail server for that number, because each user is assigned a quota of 500 MB

***Quota*=** 500 MB

***No. Users*=** 22

***Storage capacity*=**500 * 22 = 11 GB

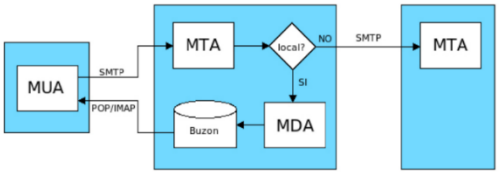
Instant Messaging Bandwidth

This is an approximate data provided by the Jabber Software Foundation. Therefore: 1000 concurrent users would consume 1000KBps. [4] That is to say that each user consumes around 1 Kbps, according to criteria and evidence of experts working with Jabber.

2.4 IDENTIFICATION OF INTEGRATED SERVICES

1) EMAIL

An e-mail system is made up of several components. The main ones are the Mail User Agent (MUA), the MTA (Mail Transfer Agent) and the MDA (Mail Delivery Agent)



Componentes de un sistema de correo electrónico

Figure 3. Components of an electronic mail system

The Mua is the program with which it is generated the email and usually resides on the client computer, for example Microsoft Outlook, the Mozilla Thunderbird, among others.

The MTA is who, via the SMTP protocol, receives the message from the MUA and decide who to deliver it. If the mail is destined to another domain, the MTA will try to contact the mail server for that domain and will transfer the message using the same SMTP protocol. If the mail is destined for a local domain, the MTA transferred internally the message to the MDA who in turn shall be responsible to place it in the respective mailbox. (Landívar, 2008)

Users can access their mailboxes using the MUA, but through protocols POP and/or IMAP, which must be active in the mail server.

Elastix used as MTA to Postfix and as MDA to Cyrus IMAP, who also provides the services of POP and IMAP. Likewise, with the Elastix comes by default a webmail interface call RoundCube Mail, the same that can be used as MUA.

Software for email

In order to handle the email accounts on a mobile device was chose for Android Roundcube, through which you can manage our email account.

2) Instant Messaging

Elastix based its instant messaging functionality in the software Openfire that works on the basis of the protocol XMPP (originally known as Jabber)

XMPP protocol (Jabber)

The fact that you use XMPP in Elastix gives us a great advantage because XMPP is a standard and there are currently many client applications compatible with this protocol. In summary, there are many options at the time of choosing a internal messaging client.

XMPP is a protocol proven, open, extensible, generally accepted, secure and based on XML. These are some of the reasons why he was chose to be part of Elastix. (Landívar, 2008)

Openfire

Openfire is a complete instant messaging system that allows us to have an instant messaging service rich in features such as file transfer, messages *broadcast*, integration with telephony, integration with other *gateways* IM, among others.

Openfire account with a user-friendly web administration interface that allows us to perform administrative tasks in an intuitive way.

Remarkable features:

- User-friendly interface of Web Administration
- Expandable functionality via *plugins*
- Interaction with other networks of instant messaging as Gtalk, Yahoo
- Allows you to create different working groups
- Creating and Managing Users
- Registration of user sessions
- Maximum number of active sessions
- Conference rooms
- Applications: spark in the case of Windows and Linux, and Xabber for mobile devices
- File Transfer
- Voice Codecs: G711, G722, alaw, Speex
- Video codecs: H264,h263, H263P,H261

Software for instant messaging

The software used to manage accounts of instant messaging is called spark in the case of work in a PC, and for mobile devices is selected the software Xabber, because it uses the XMPP protocol, in such a case, any software that use this protocol may be used.

3) videoconferencing

- Use of SIP protocol
- Configuring SIP Extensions
- Softphones: X-lite, Zoiper, Jitsi
- Another alternative is that Jitsi has some services attachments such as the association of a XMPP account, which was already configured on Openfire, and can be used in this softphone.

- Consists in adding the XMPP account to Jitsi, and this in turn is compatible with spark, the advantage of Jitsi is that it allows us to create sessions or conferences and add more contacts within the same video conferencing.

Software for video conferencing

- In the case of video conference you can work with X-lite, Jitsi
- For mobile devices will be used the software Zoiper or Voip by Antisip, for testing was conducted with the softphones x-lite and zoiper, but to have a better quality and video when there are more participant and you want that videoconferencing is interactive used the softphone and Voip by Antisip Jitsi.

2.5 FACTORS THAT INFLUENCE THE BANDWIDTH OF A NETWORK OF VOICE AND DATA

Table III

Factors that influence the bandwidth

FACTOR	DESCRIPCIÓN
Velocidad del paquete	Derivado del período de empaquetamiento
Tamaño de empaquetamiento (Tamaño del payload)	Depende del periodo de empaquetamiento Depende el ancho de banda del códec
Overhead[37] de capa de enlace	Depende del protocolo usado en la capa enlace
Overhead de capa red y transporte (Incluyendo IP, UDP y RTP)	Depende del uso o no de cRTP
Overhead de túnel	Depende el protocolo usado (IPSec[38], o MPLS)

Performance indicators of voice and data

In a network of voice and data services is necessary to provide acceptable levels of access and minimum parameters of quality of service for which it is required to establish indicators about the performance of each service. These indicators can be:

- Acceptable level of throughput (bps)
- Acceptable level of delay (ms) less than 150ms (ITU-T Recommendation G.114)
- Jitter less than 100ms
- Packet loss less than 1%

To determine the presence or level of criticality of the parameters mentioned above, is to capture the traffic in a network point remotely and on ends of the network; to which it makes use of a sniffer, in this case use will be made of the software tool called Wireshark, for being one of the most powerful analyzers for its ease of use, user-friendly interface, a large number of features and the management of multiple protocols.

3. Results

Once installed the communication server in the cloud platform and also configured their services such as: email, instant messaging and video conferencing, the tests to be performed are intended to corroborate that has a compliance of design which is raised and that all services work properly and are adapted to the needs and requirements before you raised. We will analyze the following cases:

- Bandwidth consumption for each application
- Jitter
- Packet Loss
- Traffic flow in peak hours
- Memory consumption and CPUen the cloud server and on the server Elastix

a) Email

In the tests of sending mail there is no greater problem, nor too consumption of resources, because this is not a connection-oriented service, I just need to know if I am or not the message regardless of time to review the other person.

What can be measured is the space that is being occupied according to the registered users, taking into account that each user is assigned between 500 and 1000 MB.

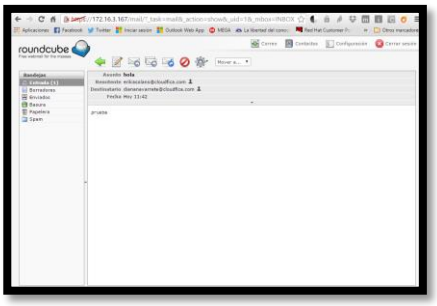


Figure 4. Proof of sending mail

TABLE IV

Email Verification Tests

Rouncube a Roundcube	✓
Roundcube a Outlook	✓
Roundcube, Outlook a Hotmail, Gmail, etc.	✓

b) Instant Messaging

Once registered users are applicable to add contacts, for which there is a process of acceptance and confirmation by the users.

Depending on the number of characters that are sent through the conversation or if you send attachments, bandwidth consumption will be minimal as shown in the tables later.

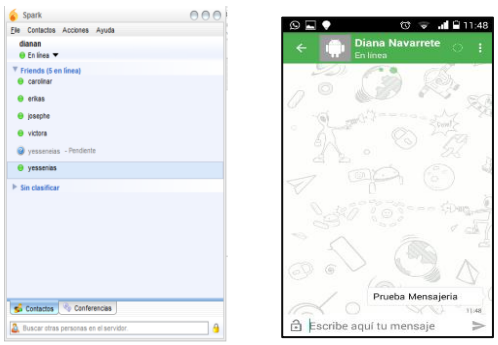


Figure 5. Spark and Xabber Users

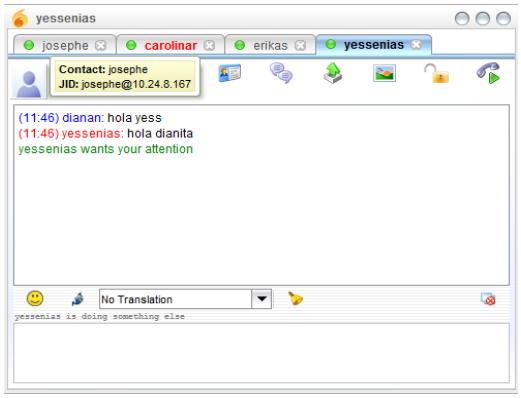


Figure 6. Conversation between users

The server displays the protocols that are running in this case which uses the Jabber instant messaging, as well as its rate of transfer rate and packages, which are used to measure the bandwidth.

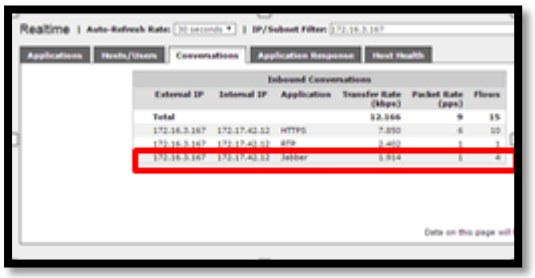


Figure 7. Server monitoring Exinda

TABLE VI

Verification tests of Instant Messaging

PC to PC	✓
PC to Mobile	✓
Mobile to Mobile	✓

It was found that the response time is instantly in the 3 cases mentioned above, there is no loss of data, which must be emphasized is that from any extension of the University until the university campus the invitation to the conversation that you normally tends to delay but in thousandths of a second.

C) Videoconferencing

The softphone works with Aryans codec in this case is used the gsm codec and in turn the codec h.263 For video, however depending on the bandwidth you have within the network, the distortion of the image, the jitter or echo, Iran by varying their values.

Likewise for measurements of performance can be noted that the capacity of the memory and the processor consumption increased considerably, and even more time to add participants to the conference

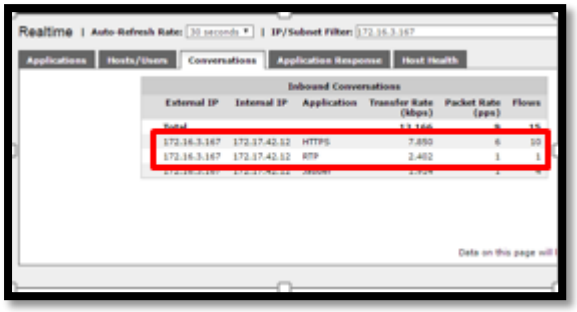


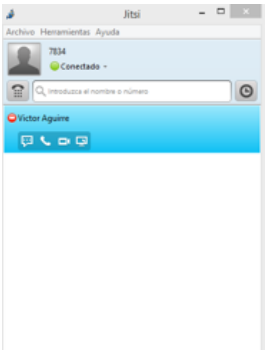
Figura 8. Videoconferencing Exinda Server monitoring

Consumption of Applications

As they were making the calls and sending messages either by mail or instant messaging what more increased was the capacity of the RAM in the CPU consumption is maintained at an average of 50%, which is acceptable, but it should be emphasized that only did the test with only a few users, that is why resizing the values of the processor and the memory, 2 CPU and 4GB RAM

Figura 9. Consumo de Memoria y CPU

Connectivity Tests



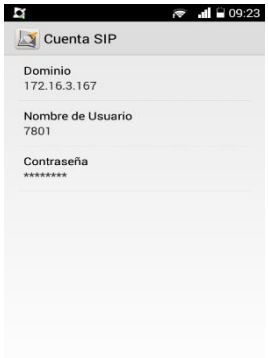


Figure 10. Registration of PC Users- Mobile

Once the connection is established you can observe that end-to-end there is a good communication and quality of the signal.

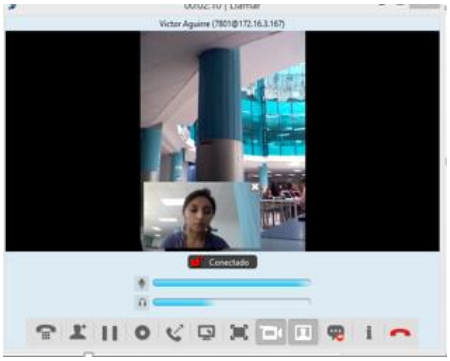


Figure 11. PC users Jitsi

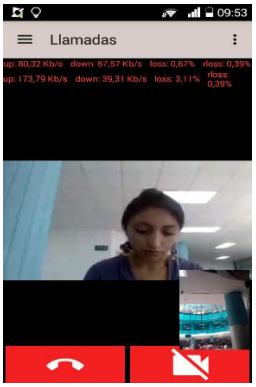


Figure 12. Mobile users- Voip by Antisip

Features inside of the videoconference this the desktop sharing, for example to make an exposure or that the user also has the option to manage or edit.

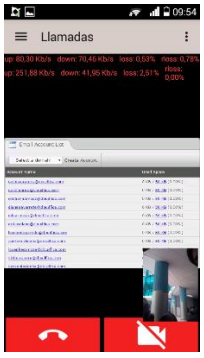


Figure 13. Mobile Desktop Comparticion- Voip by Antisip

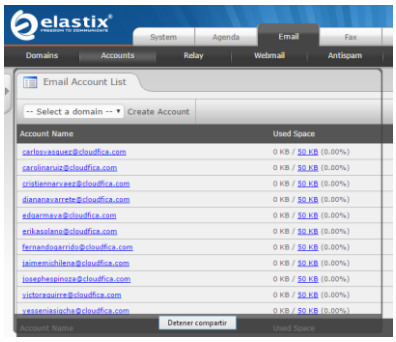


Figure 14. PC Desktop Sharing

4. Conclusions

We have implemented a Unified Communications platform in the cloud, in order to improve communication within the institution and improving the processes, which made it possible to expand a series of services that work under the free software platform.

Was the design of the Unified Communications System, defined a sizing the service, both of software, hardware, users, as well as of each service according to parameters proposed, in this case bandwidth, machines capacity, performance, traffic flow, etc.

Infrastructure as a service that provides the platform for cloud computing, brings other types of cloud when you install the Unified Communications Server, it is the case that the communication server indirectly is providing software as a service known as SAAS, which the user only makes use of the software and the application without having to worry about maintenance of infrastructure or servers.

Installed the Unified Communications services in the two platforms in the cloud, as due to the incompatibility of signaling protocols used for videoconferencing in Open Stack, worked with Open Nebula in which the videoconferencing service operates correctly according to the benefits and features that handles the videoconference.

Using the tool Wireshark is carried out a procedure for capturing packets, which tested the performance and connectivity of the platform and the services, respectively, with the obtaining of the reports generated by the server Exinda which belongs to the University was observed on traffic that generates each service with the purpose of validating whether it complies with the requirements of dimensioning of the same and the characteristics of the design.

Due to the optimization of resources and deployment of services, the virtualization of the same, has marked trend, allowing the administration of the infrastructure itself, reducing deployment costs and the consumption of resources that generates each machine hosted in the Cloud.

Taking into account that the network of the University does not have policies on quality of service, the tests that were conducted with each service in a 50% in the case of video conference showed the deterioration of quality in each call, due to packet loss ranged from 5 to 17% per session, and jitter exceeded the average value where a transmission is acceptable, for the rest of the services the connectivity and availability of the same result was satisfactory.

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Bibliographical References

[1] Arévalo, J. M. (2011). *Universidad Rey Juan Carlos.* Obtenido de Cloud Computing: fundamentos, diseño y arquitectura: https://eciencia.urjc.es/bitstream/handle/10115/5945/MemoriaTFMFINAL-2.pdf?sequence=1&isAllowed=y

[2] *Blog TELEFONIA VoIP*. (s.f.). Obtenido de http://telefoniausandovoip.blogspot.com/2011_01_01_archive.html

[3] *CISCO.* (Mayo de 2008). Obtenido de http://www.cisco.com/cisco/web/support/LA/7/73/73295_bwidth_consume.html

[4] *Jabber, Mensajeria instananea Libre*. (s.f.). Obtenido de https://www.jabberes.org/node/501

[5] Landívar, E. (2008). *Comunicaciones unificadas con Elastix* (Vol. II). Quito, Ecuador: no definido.

[6] Villalon, J. L. (s.f.). *Security Artwork*. Obtenido de http://www.securityartwork.es/2008/02/27/voip-protocolos-de-transporte/

[7] *TOGA SOLUCIONES*. (s.f.). Obtenido de https://togasoluciones.wordpress.com/2013/02/06/la-importancia-de-las-comunicaciones-unificadas/

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