UNIVERSIDAD TÉCNICA DEL NORTE

FACULTAD DE INGENIERÍA EN CIENCIAS APLICADAS

CARRERA DE INGENIERÍA EN ELECTRÓNICA Y REDES DE COMUNICACIÓN

POLICY IMPLEMENTATION OF BANDWIDTH ALLOCATION FOR DATA NETWORK OF UNIVERSIDAD TÉCNICA DEL NORTE

SCIENTIFIC ARTICLE

AUTHOR: ELSA IRENE PERALTA BURBANO

TUTOR: ING. JOSÉ ROBERTO MARCILLO DEL CASTILLO

IBARRA-ECUADOR

2016

POLICY IMPLEMENTATION OF BANDWIDTH ALLOCATION FOR DATA NETWORK OF UNIVERSIDAD TÉCNICA DEL NORTE

Elsa Irene Peralta Burbano

Facultad de Ingeniería en Ciencias Aplicadas
Ibarra, Ecuador
eiperaltab@utn.edu.ec

Tutor: Ing. Roberto Marcillo
jrmarcillo@utn.edu.ec

Abstract. - The implementation of policies bandwidth allocation for the data network of the Technical University of the North, was carried out in order to optimize bandwidth management by Exinda team. In the first instance it was investigated on theoretical foundations of: segmenting networks, virtual local area, types of network traffic, also on the characteristics and features of PacketShaper equipment, which allowed monitoring and subsequent analysis of the network.

an analysis of the current situation of the network of university house both physical and logical part is then conducted to know the operation and requirements of it by the PacketShaper team which served as a monitoring tool to assess consumption bandwidth of all VLANs of the institution. Then the G.1010 recommendation for the establishment of priorities in the revised network also took into consideration the criteria of experts and the network administrator to perform the most appropriate segmentation based on the needs of each department of the institution.

I. INTRODUCTION

The Universidad Técnica del Norte has grown both in physical and technological infrastructure, the large number of users accessing network services generate multiple types of traffic that require different bandwidths. This increase has caused communication channels are saturated and that management bandwidth is zero.

The institution previously had a manager bandwidth called PacketShaper team, but this did not cover the current demand for bandwidth is 450 Mbps, since it had a limited licensing of 45 Mbps and has also reached the end of life.

In order to improve management and gestionamiento network the institution purchased a new computer administrator bandwidth called Exinda, where allocation policies bandwidth policies and resource optimization were implemented to improve network management of data.

For the correct allocation of bandwidth, it was taken into consideration standardized parameters as G.1010 recommendation and expert judgment network management.

II. DEVELOPMENT

The study of both the physical part was held in the main connectivity's and logic part diagnose allowing the operation and needs of the data network.

A. Analysis of the physical topology of the network

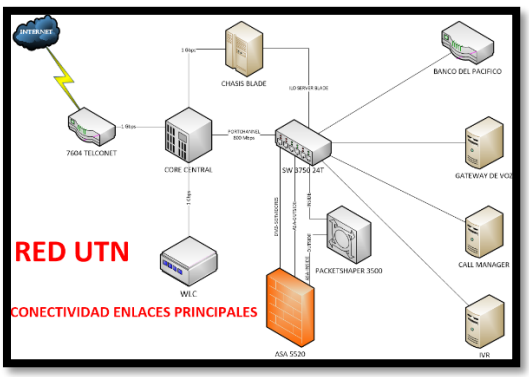

Figure 1. Main links UTN topology. Excerpted from DDTI UTN.

Currently the network UTN within the layer of Core there is a router 7604 which serves as a link to your internet service provider "TELCONET SA" for the university which provides a bandwidth of 450 Mbps through an agreement maintaining this educational institution with CEDIA.

The structure of the internal network of the Technical University of the North is composed of 2 Cisco 4506-E within the distribution layer, which are located on the ground floor of the central building, within the Department of Computer located in the cold room, which is administered by the Department of Networks. Servers and various network equipment are distributed within existing racks in the Fourth Frio Department of Information Technology for different applications and services for teachers, students and university staff, the department currently has two racks where assemble the various network devices.

B. Analysis of the physical topology of the network

Currently the internal data network UTN is divided by 49 VLANs managed by the Switch Catalyst 4510-E, the administration of these are made either via telnet and SSH access.

The creation of these VLANs is made based on the capabilities and needs of each of the units of the institution.

Table 1.
Distribution of subnetworks (VLANs) data network of the institution.

N°	DESCRIPTION	VLAN
1	EQUIPOS-ACTIVOS	1
2	DMZ	2
3	NAT-INTERNO-DMZ	3
4	IPs-PUBLICAS 190.95.196.192/27	4
5	EQUIPOS-ACTIVOS-WIRELESS	5
6	CCTV	6
7	RELOJES-BIOMETRICOS	7
8	TELEFONIA-IP-ELASTIX	8
9	IPs-PUBLICAS 186.5.55.192/26	9
10	TELEFONIA-IP-CISCO	10
11	AUTORIDADES	12
12	DDTI	14
13	FINANCIERO	16
14	COMUNICACION-ORGANIZACIONAL	18
15	ADMINISTRATIVOS	20
16	ADQUISICIONES	22
17	U-EMPRENDE	24
18	AGUSTIN-CUEVA	26
19	BIENESTAR-DOCENTES	28
20	BIENESTAR-ADMINISTRATIVOS	30
21	NATIVA	39
22	FICA-LABORATORIOS	40
23	FICA-ADMINISTRATIVOS	44
24	FICAYA-LABORATORIOS	48
25	FICAYA-ADMINISTRATIVOS	52
26	FECYT-LABORATORIOS	56
27	FECYT-ADMINISTRATIVOS	60
28	FACAE-LABORATORIOS	64
29	FACAE-ADMINISTRATIVOS	68
30	FCCSS-LABORATORIOS	72
31	FCCSS-ADMINISTRATIVOS	76
32	POSTGRADO-LABORATORIOS	80
33	POSTGRADO-ADMINISTRATIVOS	84
34	CAI-LABORATORIOS	88
35	CAI-ADMINISTRATIVOS	92
36	BIBLIOTECA-LABORATORIOS	96
37	BIBLIOTECA-ADMINISTRATIVOS	100
38	COLEGIO-LABORATORIOS	104
39	COLEGIO-ADMINISTRATIVOS	108
40	WIRELESS-DOCENTES	112
41	WIRELESS-ADMINISTRATIVOS	120
42	EDUROAM	128
43	WIRELESS-EVENTOS1	160
44	WIRELESS-EVENTOS2	168
45	WIRELESS-ESTUDIANTES	192
46	COPIADORA	201
47	BANCO-PACIFICO	202

Source: Recovered from the Department of Computer Technology and Development.

C. Traffic Analysis

To monitor traffic throughout the network the PacketShaper team who served in consumption analysis bandwidth, determining the percentage utilization of bandwidth in real time, and information on the average use applications that are used are connected for each of the VLANs and set the bandwidth required by each.

each of monthly consumption VLANs bandwidth reports were generated and determining that application had increased consumption in each.

Table 2.
Bandwidth using the one-month period.

VLAN	AVERAGE (bps)	PEAK (bps)
TRÁFICO INBOUND	149,5 M	538 M
EQUIPOS ACTIVOS	0,03 M	5,1 M
AUTORIDADES	2,8 M	27 M
DDTI	3,67 M	170 M
FINANCIERO	1,30 M	82 M
COMUNICACIÓN ORGANIZACIONAL	2,74 M	97,8 M
ADMINISTRATIVOS	4,64 M	82 M
ADQUISICIONES	0,60 M	19,9 M
U- EMPRENDE	1,46 M	26 M
AGUSTÍN CUEVA	0,28 M	12,5 M
BIENESTAR DOCENTE	1,83 M	180 M
BIENESTAR ADMINISTRATIVOS	0,87 M	47,9 M
FICA LABORATORIOS	9,67 M	80 M
FICA ADMINISTRATIVOS	6,39 M	81,5 M
FICAYA LABORATORIOS	4 M	71,5 M
FICAYA ADMINISTRATIVOS	2,69 M	110 M
FECYT LABORATORIOS	9,33 M	52 M
FECYT ADMINISTRATIVOS	4,8 M	92 M
FACAE LABORATORIOS	12,67 M	420 M
FACAE ADMINISTRATIVOS	2 M	86 M
FCCSS LABORATORIOS	4,86 M	37,3 M
FCCSS ADMINISTRATIVOS	1,11 M	66 M

VLAN	AVERAGE (bps)	PEAK (bps)
POSTGRADO LABORATORIOS	0,83 M	28 M
POSTGRADO ADMINISTRATIVOS	1,18 M	39,5 M
CAI LABORATORIOS	2,82 M	20 M
CAI ADMINISTRATIVOS	0,78 M	41,5 M
BIBLIOTECA LABORATORIOS	12,67 M	43,3 M
BIBLIOTECA ADMINISTRATIVOS	2,93 M	15 M
COLEGIO LABORATORIOS	0,57 M	23 M
COLEGIO ADMINISTRATIVOS	1,69 M	31 M
WIRELESS DOCENTES	2,67 M	21 M
WIRELESS ADMINISTRATIVOS	2,1 M	23 M
EDUROAM	0 M	0 M
WIRELESS EVENTOS 1	1,87 M	19 M
WIRELESS EVENTOS 2	5 M	46 M
WIRELESS ESTUDIANTES	22 M	100 M
COPIADORA	4,8 M	10 M

Source: Compiled from PacketShaper UTN.

D. Description of the applications used by the data network.

For a better understanding of the applications that appear in the reports, a list of the applications that are used by each VLAN detected by the PacketShaper detailed computer.

BITS: The BITS (Microsoft Background Intelligent Transfer Service) for its acronym in Spanish is the Intelligent Transfer Service in the background. (Gallardo, 2006)

HTTP: The HTTP protocol generally uses port 80. HTTP is based on the client-server model, where an HTTP client (a browser, for example) opens a connection and make a request to the server. (HTTP, 2010)

SMTP: SMTP (Simple Mail Transfer Protocol), it is one of the most common protocols used to send emails on the Internet. (Colomés, 2010)

SOAP-HTTP: SOAP part of a simple idea, ensure communication between heterogeneous teams, based on existing protocols, widespread and implemented (como HTTP y XML). (Lopez J., 2001)

SSL: El SSL (Security Socket Layer) it is a transparent method for establishing a secure session that requires minimal intervention by the end user. (Sign, 2010)

SSH: Secure Shell, also called SSH, is a protocol used for the login and remote process execution. (Smaldone, 2004)

DNS: Stands for Domain Name System (domain names) and is a technology based on a database that is used to resolve names on the network, i.e. to know the IP address of the machine that is hosting the domain that we want access. (Quiroga, 2011)

ICMP: It is a control protocol (Internet Control Message Protocol), used to warn of errors in the processing of datagrams, ie IP packets. (LCo, 2010)

ORACLE: Oracle Database management system is a database of type object-relational (ORDBMS, the acronym for Object-Relational Data Base Management System), developed by Oracle Corporation. (Oracle, 2014)

APPLE-iTUNES: Apple-iTunes is a media player and store multimedia content developed by Apple in order to play, organize and sync iPods, iPhones, iPads and buy music. It is compatible with computers based operating systems Mac OS X, Windows 2000, Windows XP, Windows Vista, Windows 7 and Windows 8. (Apple, 2003)

FLASHVIDEO: Flash Video (FLV) container is a proprietary format used to transmit video over the Internet using Adobe Flash Player (formerly known as Macromedia Flash Player) from version 6 through 10. (Matthijskamstra, 2006)

IMAP: IMAP It is short for "Internet Message Access Protocol". IMAP offers the ability to manage your e-mails directly on the server E-Mail, that is, if you choose the IMAP protocol to set up your email account in your program E-Mail, mail you receive will not be downloaded to your computer, but simply receive a list of your messages and related matters. (Delgado, 2014)

MPEG-AUDIO: MPEG-1 the meaning of its acronym (Moving Pictures Experts Group) works in Layer I or II audio is a coder subband generic operating at bit rates in the range of 32 to 448 kb / s and support sampling frequencies 32, 44.1 and 48 kHz. Typical rates for layer II bits are in the range 128-256 kbit / s, and 384 kb / s for professional applications. (Quackenbush, 2005)

LOTUS-IM: “Lotus IM It allows users to communicate with text, audio and video as well as online meetings with whiteboard and application sharing. (McKean, 2005)

POP3: POP3 in its acronym in English means (Post Office Protocol), it was designed to allow processing email offline. (Corporation, 2012)

EARTHSTATION: P2P software to download all kinds of files from both Kazaa and Gnutella from. (Downsoft, 1999)

MPEG-VIDEO: MPEG2 It is widely used as the format of digital television signals that are broadcast by terrestrial, cable television systems and direct broadcast satellite. (Quackenbush, 2005)

OGG: Ogg bitstream format is a container that offers high efficiency in streaming and file compression. Like most container formats, Ogg encapsulates compressed data allowing interpolation audio data and video into one convenient format. (Vorbis, 2003)

POSTGRESQL: PostgreSQL is a management system database, object-relational, distributed under BSD license and its source code freely available. (Ma., 2010)

REMOTELYANYWHER: RemotelyAnywhere is a process belonging to 3:00 a.m. Laboratories, remote administration of the tool Remotely Anywhere. This process allows other users to control your PC via a local network or the Internet. (Libary, 2013)

YOUTUBE: This platform has an online player based on Flash, the format developed by Adobe Systems. (Definición, 2013)

QUICKTIME: QuickTime It is a standard multimedia framework developed by Apple that consists of a set of libraries and a multimedia player (QuickTime Player). (Blackboard, 2007)

RDP: RDP (Remote Desktop Protocol) It is based and is an extension of the family of T-120 standard protocol. (Microsoft S., 2013)

SOULSEEK: It is a P2P network and exchange of computer files used primarily for sharing music, although it allows the transit of all kinds of application files. (Mayoraz, 2012)

VNC: VNC (Virtual Network Computing), It is generally used by system administrators to manage remote computers, can be used for many small computers, they can access an application server powerful. (Becerro, 2005)

WAP: WAP (Wireless Application Protocol), It is as its name indicates a protocol for wireless applications. (Navarro, 2012)

AOL-AIM-ICQ: AOL-AIM (America-On-Line Instant Messenger) is an instant messaging client America Online Instant Messenger commonly referred. (Descargar, 2011)

BITTORRENT: BitTorrent is a program created protocol for peer file sharing (peer to peer or P2P), created by Bram Cohen, American programmer. (Alegsa, Definición de BitTorrent, 2010)

CIFS: CIFS (Common Internet File System), is an exchange protocol based on Internet protocol files, CIFS uses the programming model client / server. Rouse, 2005)

DAY-TIME: Daytime is a computer communications protocol that uses port 13 (TCP and UDP). (Postel, 1983)

DCOM: DCOM (Distributed Component Object Model). The Component Object Model (COM) Microsoft is an object-oriented system, distributed and independent of the platform used to create binary software components that can interact. (Microsoft, 2014)

JABBER: Jabber is a simple freeware virus free that lets you work easily with various email accounts in order to no longer rely on other applications, also offers the possibility of speaking, simultaneously, with users who have mail accounts mail on MSN, ICQ, Yahoo and Gtalk. (Sagarra, 2014)

NETBIOS-IP: NetBIOS, Basic Input Output System Network is an IBM standard protocol that allows applications on different computers to communicate within a local area network (LAN). (Cea, 2015)

RTSP: RTSP is an application layer protocol, no connection-oriented. Instead RTSP server maintains a session associated with an identifier (Session ID). (Apablaza, 2014)

SKYPE: Skype is a freeware application that allows Internet phone calls (VoIP). (Alegsa, Definition de Skype, 2009)

GNUTELLA: The Gnutella network works in a distributed environment model. This network consists of many nodes in the world, its topology does not indicate any hierarchy since each node has the same functionality. (Sava, 2001)

SIP: The SIP protocol (which stands for Session Initiation Protocol) was born in 1996 when Mark Handley and Schooler Eve presented the first draft to the IETF what would be an IP communications protocol that would solve many of the drawbacks of previous protocols. (Rojano, Aclarando conceptos sobre SIP y VoIP, 2015)

SHOUTCAST: SHOUTCAST is a website where are stored thousands of streaming radio urls, and this application allows us to have them on the iPhone. (Beiro, 2009)

LDAP: Protocol Lightweight Directory Access, better known as LDAP (for its acronym in English), is based on the X.500 standard, but significantly simpler and more truly adapted to meet the needs of the user. (Donnelly, 2000)

ACTIVEX: ActiveX is a standard developed by Microsoft that allows the interaction of software components in a networked environment regardless of the language in which they were created. (AGOSTINI, 2001)

E. Requirements for segmenting Bandwidth

Requirements analysis and allocation priority levels for each of the applications: it was done in conjunction with the Department of Computer Technology and Development of the Universidad Técnica del Norte.

Table 3.
Classification of applications UTN.

PRIORITY	APPLICATION	CLASS
CRITICAL	TELEFONÍA IP	TELEFONÍA
	SEÑALIZACIÓN	
	VIDEO CONFERENCIA	VIDEO
	VIDEO STREAMING	
HIGH	BASE DE DATOS	BDD
MEDIUM	DNS	DNS
SLOW	DHCP	DHCP
DEFAULT	CUALQUIER OTRO	DEFAULT

Fuente: Source: Recovered Optimization bandwidth Internet access and traffic control of the Universidad Técnica del Norte applying quality of service (QoS), Diego Paspuel 2014.

Once the audit bandwidth consumption, and based on the collection of data to determine an approximate number of users per VLAN, we proceed to analyze QoS requirements established by the recommendation G.1010.

This Recommendation defines a model categories quality of service (QoS) for multimedia services from the viewpoint of the end user. Given the user's expectations with respect to various multimedia applications, eight different categories are determined by not tolerate or information loss and delay. These categories are intended to serve as a basis for defining realistic QoS classes for underlying transport networks and control mechanisms of the corresponding QoS.

F. Prioritization for each VLAN.

Table 4.
VLANs prioritized.

N°	DESCRIPTION	PRIORITY
1	EQUIPOS-ACTIVOS	CRÍTICA
2	AUTORIDADES	CRÍTICA
3	DDTI	CRÍTICA
4	FINANCIERO	CRÍTICA
5	COMUNICACION-ORGANIZACIONAL	CRÍTICA
6	ADMINISTRATIVOS	MEDIA
7	ADQUISICIONES	CRÍTICA
8	U-EMPRENDE	BAJA
9	AGUSTIN-CUEVA	BAJA
10	BIENESTAR-DOCENTES	BAJA
11	BIENESTAR-ADMINISTRATIVOS	ALTA
12	PROYECTO - INDIA	ALTA
13	FICA-LABORATORIOS	ALTA
14	FICA- WIRELESS	ALTA
15	FICA-ADMINISTRATIVOS	MEDIA
16	FICAYA-LABORATORIOS	MEDIA
17	FICAYA-ADMINISTRATIVOS	MEDIA
18	FECYT-LABORATORIOS	MEDIA
19	FECYT-ADMINISTRATIVOS	MEDIA
20	FACAE-LABORATORIOS	MEDIA
21	FACAE-ADMINISTRATIVOS	MEDIA
22	FCCSS-LABORATORIOS	MEDIA
23	FCCSS-ADMINISTRATIVOS	MEDIA
24	POSTGRADO-LABORATORIOS	BAJA
25	POSTGRADO-ADMINISTRATIVOS	MEDIA
26	CAI-LABORATORIOS	BAJA
27	CAI-ADMINISTRATIVOS	MEDIA
28	BIBLIOTECA-LABORATORIOS	MEDIA
29	BIBLIOTECA-ADMINISTRATIVOS	MEDIA
30	COLEGIO-LABORATORIOS	BAJA
31	COLEGIO-ADMINISTRATIVOS	MEDIA
32	WIRELESS-DOCENTES	CRÍTICA
33	WIRELESS-ADMINISTRATIVOS	CRÍTICA
34	EDUROAM	CRÍTICA
35	WIRELESS-EVENTOS1	BAJA
36	WIRELESS-EVENTOS2	BAJA
37	WIRELESS-ESTUDIANTES	CRÍTICA
38	COPIADORA	BAJA

Fuente: Elaboration proper.

III. POLICY IMPLEMENTATION

A. Determination of the number of users in each VLAN.

This information was requested from the DDTI to determine an average number of users per VLAN.

B. Equipment connection bandwidth manager EXINDA

Prior to the implementation of the bandwidth segmentation connection Exinda equipment was performed as shown in Figure 2:

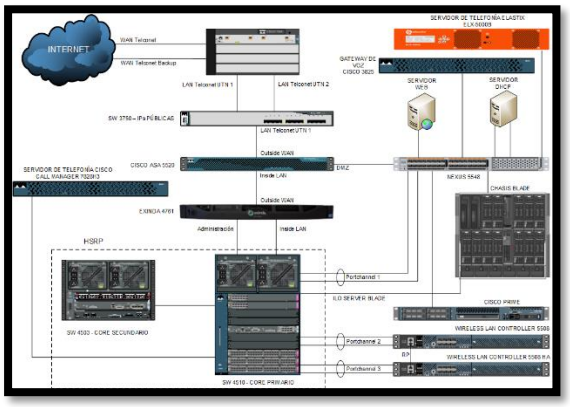

Figure 2. Diagram main connections UTN. DDTI.

Administrator bandwidth Exinda computer is connected between the Firewall (ASA-5520) and the switch Core-4510 is the team that manages all VLANs of the institution, being the WAN connection to the ASA computer and connection LAN the Core. The connection mode is the brigde team Exinda mode allowing the team to manage over 1 Gbps of internal traffic.

C. SEGMENTATION OF BANDWIDTH.

Based on the criterion based on experience in network management experts it has determined that the formula for bandwidth for a link is (Acosta, 2010):

$$AB=G*C \quad (1)$$

Where:

AB: Given bandwidth.
G: Guaranteed bandwidth per user.
C: Number of concurrent users on the network.
N: Total number of users.

For application of this formula is necessary to know the number of concurrent users in each of the VLANs and bandwidth is intended to allow each user to each of the VLANS data network.

Once done the analysis of consumption of bandwidth applications, it determined that the required bandwidth based on application usage is 2306.80 Mbps being 512% of the contracted bandwidth, obtained this value again analyze applications which are mostly consumed bandwidth for adequate distribution and having determined the priority for each VLAN the following result was obtained bandwidth allocation based on the equation (1):

D. IMPLEMENTATION OF CERTAIN BAND WIDTH EACH VLAN

After completing the segmentation by the formula, on the recommendation of the technical bandwidth percentage assigned.

Before assigning VLANs criticisms determined, these VLANs are created with two levels of bandwidth a minimum and a maximum, the minimum value assigned and no deal is always available for that VLAN, the maximum value may be used as long when the other VLAN are not occupying the bandwidth it deserves.

On the recommendation of technical sebe not assign exactly the value that is available should be overestimating a value considered based on the needs of each VLAN.

Creating objects (VLANs) in the device EXINDA.

For creating VLANs only they take into account the VLANs that are output internet VLANs are shown in Table 5.

The creation of objects (VLANs) was performed as follows:

Go to **Object** tab located on the left side and choose the option **Network.**

- **Name:** VLAN name to create, in this case under.
- **Location:** Internal.

Active the box **Subnet Report.**

In **Subnets: IP Network Address / Mask Length**; write the address assigned subnet, and mask.

Then click on: **Add New Network Object**.

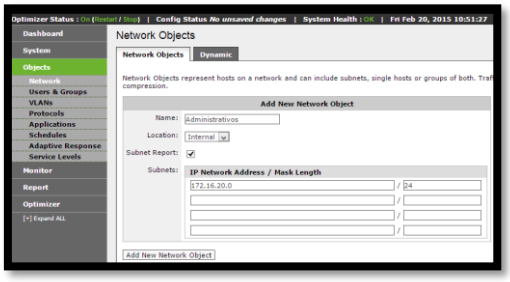

Figure 3. Creating network object. Extracted from EXINDA 4061 UTN.

Once you have created appear in the list of objects:

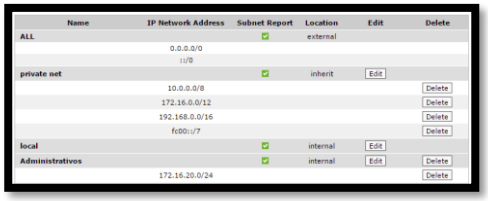

Figure 4. List of network objects created. Extracted from EXINDA 4061 UTN.

In total 38 objects network found in the list below they were created.

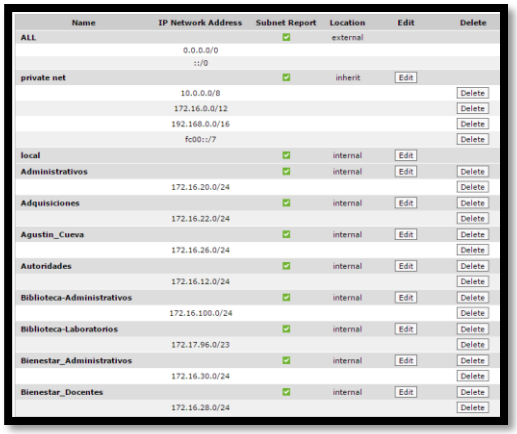

Figure 5. List of network objects created. Extracted from EXINDA 4061 UTN.

Creation of the global circuit

In this part of the creation of the global circuit in which the total bandwidth is allocated to the institution that has made.

To create the circuit went to the left side of the interface and ***Optimizer*** option was chosen, and then click ***Create New Circuit.***

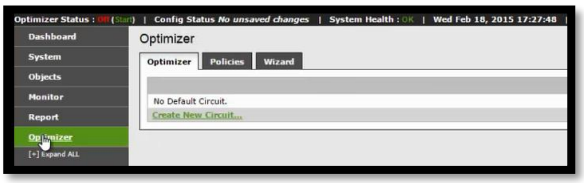

Figure 6. *Creation of the new circuit. Extracted from EXINDA 4061 UTN.*

Table 5.

Bandwidth required by VLAN.

	AB TOTAL Mbps	450	N	C	G	AB= G * C (Mbps)
N°	DESCRIPTION	VLAN	# USERS	# CONCURRENT USERS	AB default user Kbps	
1	EQUIPOS-ACTIVOS	1	1	1	1024,00	1
2	AUTORIDADES	12	11	11	1024,00	11,00
3	DDTI	14	30	24	1024,00	24,00
4	FINANCIERO	16	20	20	1024,00	20,00
5	COMUNICACION-ORGANIZACIONAL	18	32	32	1024,00	32,00
6	ADMINISTRATIVOS	20	300	300	256,00	75,00
7	ADQUISICIONES	22	6	6	1024,00	6,00
8	U-EMPRENDE	24	30	20	64,00	1,25
9	AGUSTIN-CUEVA	26	10	5	64,00	0,31
10	BIENESTAR-DOCENTES	28	171	171	64,00	10,69
11	BIENESTAR-ADMINISTRATIVOS	30	4	4	1024,00	4,00
12	PROYECTO - INDIA	28	60	55	512,00	27,50
13	FICA-LABORATORIOS	40	163	163	256,00	40,75
14	FICA- WIRELESS	42	500	467	512,00	233,50
15	FICA-ADMINISTRATIVOS	44	18	18	256,00	4,50
16	FICAYA-LABORATORIOS	48	92	92	128,00	11,50
17	FICAYA-ADMINISTRATIVOS	52	21	21	256,00	5,25
18	FECYT-LABORATORIOS	56	132	132	128,00	16,50
19	FECYT-ADMINISTRATIVOS	60	14	14	256,00	3,50
20	FACAE-LABORATORIOS	64	129	129	256,00	32,25
21	FACAE-ADMINISTRATIVOS	68	14	14	256,00	3,50
22	FCCSS-LABORATORIOS	72	72	72	128,00	9,00
23	FCCSS-ADMINISTRATIVOS	76	17	17	256,00	4,25

	AB TOTAL Mbps	450	N	C	G	AB= G * C (Mbps)
N°	DESCRIPCIÓN	VLAN	# DE USUARIOS	# USUARIOS CONCURRENTES	AB predeterminado por usuario Kbps	
24	POSTGRADO-LABORATORIOS	80	57	57	128,00	7,13
25	POSTGRADO-ADMINISTRATIVOS	84	4	4	256,00	1,00
26	CAI-LABORATORIOS	88	50	50	256,00	12,50
27	CAI-ADMINISTRATIVOS	92	1	1	256,00	0,25
28	BIBLIOTECA-LABORATORIOS	96	43	43	256,00	10,75
29	BIBLIOTECA-ADMINISTRATIVOS	100	15	15	256,00	3,75
30	COLEGIO-LABORATORIOS	104	50	35	256,00	8,75
31	COLEGIO-ADMINISTRATIVOS	108	3	3	256,00	0,75
32	WIRELESS-DOCENTES	112	388	65	1024,00	65,00
33	WIRELESS-ADMINISTRATIVOS	120	300	80	128,00	10,00
34	EDUROAM		0	0	128,00	0,00
35	WIRELESS-EVENTOS1	160	350	180	128,00	22,50
36	WIRELESS-EVENTOS2	168			128,00	
37	WIRELESS-ESTUDIANTES	192	7758	1872	128,00	234,00
38	COPIADORA	201	20	20	64,00	1,25
			10886			**954,88**

Source: Self-made.

Once obtained the result of assignment shown in Table 5, a new analysis is done and the team manager bandwidth Exinda to assign bandwidth in two ways kbps or in percentages, the default bandwidth per user as explained above was based on the priority of each of the VLANs.

First, the creation of a global circuit in which it is allocated total bandwidth with which the university has Kbps value that are performed total 460800 Kbps.

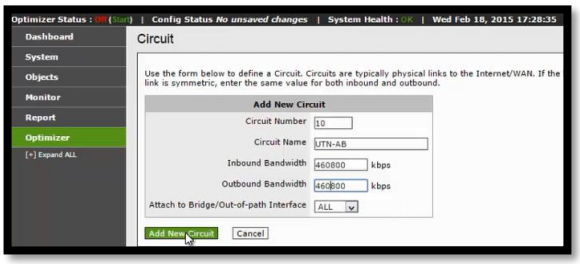

Figure 7. Creation of the new circuit. Extracted from EXINDA 4061 UTN.

Creating virtual circuits

After creating the overall circuit virtual circuits that are VLANs for bandwidth allocation they were created, for this we click ***Create New Virtual Circuit***:

Figure 8. Creating a new virtual circuit. Extracted from EXINDA 4061 UTN.

First they had to create VLANs criticism, these VLANs have two levels of bandwidth allocation.

Figure 9. Creating a new virtual circuit. Extracted from EXINDA 4061 UTN.

- **Virtual Circuit Number:** Value based on the order they are wishing circuits.
- **Virtual Circuit Name:** Name virtual circuit in this case VLAN.
- **Schedule:** In that time, you want this circuit is active.
- **Virtual Circuit Bandwith:** Maximum bandwidth.
- **Oversubscription:** if the VLAN requires two levels of bandwidth allocation must activate the box ***Manual*** otherwise leave it ***Automatic***.
- **Guaranteed Bandwidth:** This option is enabled in the event that is selected box Manual, here is the minimum bandwidth.
- **VLAN Object:** ***ALL.***
- **Network Object:** the network object to which it belongs is selected.
- **Application:** Here is selected for the type of application you want to apply the policies of this circuit, but in this case the option is chosen **ALL.**
- **Direction:** ***Both***, in both directions.

And finally ***Add New Virtual Circuit***

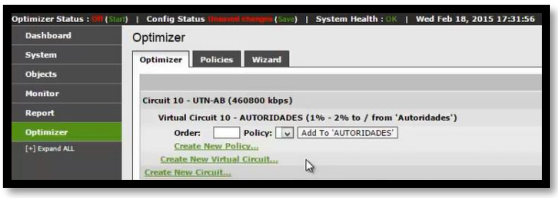

Figure 10. Viewing the new virtual circuit created. Extracted from EXINDA 4061 UTN.

This procedure is repeated for the rest of VLANs, only changes in the VLANs that have only one level of bandwidth allocation as follows:

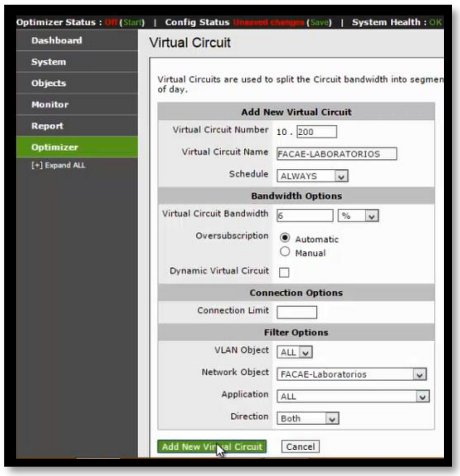

Figure 11. Creating a new virtual circuit level. Extracted from EXINDA 4061 UTN.

In this second mode of creating the virtual circuit shown in Figure 12, the only change is the allocation of bandwidth **Bandwith Options** tab in the part of **Oversubscription** should choose the option ***Manual***.

Once done the calculations for allocating bandwidth, a new analysis was performed because the bandwidth on the recommendation of the technician was assigned in value percentages more easily in case of increasing the total bandwidth of

the university house, also due overstate the actual value has available the total bandwidth.

Each of the created circuits appear as follows:

Figure 12. List of virtual circuits created. Extracted from EXINDA 4061 UTN.

Creating policies restricting bandwidth

For better bandwidth optimization, the Exinda equipment allows the creation of policies which can allow or deny services, block ports, pages or applications outright or partial.

For the creation of policies can be restricted to a particular application or group of applications. Exinda team also lets you create an application or group of applications is based on the need for the network administrator.

The following policies were created:

- Blocking Social Networking
- Blocking Games.
- Blocking -Pornografía
- Recreacional
- P2P
- Streaming
- Blocking Web

Each of these policies belongs to a certain group of applications previously created in the Exinda team, before the creation of policies should determine which application or application group will proceed to block or allow partially. Next, it details how the creation of policies held:

Blocking Social Networking

This policy was created to block access to social networks such as Facebook, Twitter, Instagram and others, so that users do not misuse the internet service within the institution this policy was created to VLANs COLEGIO LABORATORIOS and COLEGIO ADMINISTRATIVOS.

The creation of the policy outlined below:

Optimizer option on the left side of the interface is then selected, once there in the ***Optimizer*** tab select the option ***Create New Policy.***

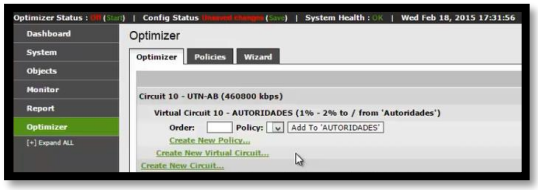

Figure 13. *Creating new policy. Extracted from EXINDA 4061 UTN.*

Then the window for creating a new policy appears:

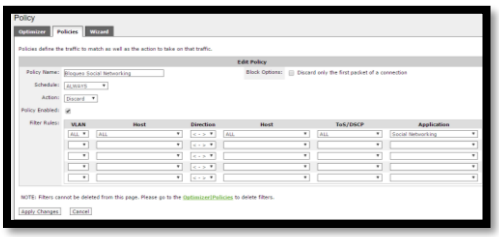

Figure 14. Creation window politics. Extracted from EXINDA 4061 UTN.

- **Policy Name:** Policy Name.
- **VC Policy Number:** Order number of policy.
- **Schedule:** Hours that you want this policy enabled.
- **Action:** the action to be performed with this policy is chosen, be optimized, discard or ignore.
- **Policy Enable:** Enables policy.
- **Guaranteed bandwith**: Guaranteed minimum bandwidth may be a percentage (%) or Kbps.
- **Burst (Max) Bandwith:** Maximum band width can be in percentage or Kbps.
- **Burst Priority:** t is the value of priority that should be given to the application or applications that are being allocated in politics.
- **Filter Rules:** In the Application column or applications that will implement the policy is chosen.

Finally, the new policy is added with click on ***Add New Policy.***

The same procedure is performed for creating other policies and depending on the need of each policy application or group of applications are created.

Once the creation of policies made are displayed as follows in the Exinda device.

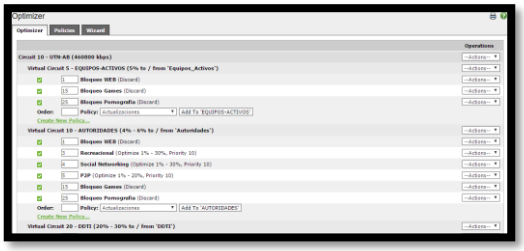

Figure 15. Viewing policies created. Extracted from EXINDA 4061 UTN.

Once you have created the policy is not necessary to create it in each virtual circuit, under each virtual circuit there is a text box Order where we set the value that will have political, policy and seek we click **Add To 'name Virtual Circuit'.**

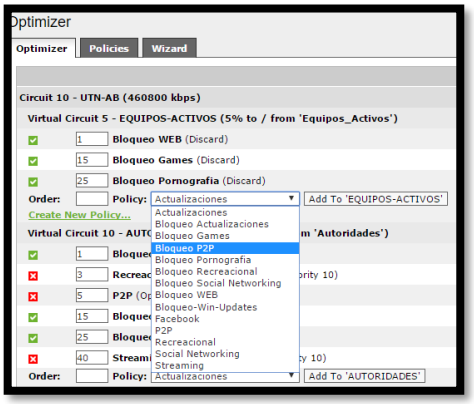

Figure 16. Policy Assignment previously created. Extracted from EXINDA 4061 UTN.

To check the allocated bandwidths and therefore has are using must go to the ***Monitor*** tab and choose the option ***Control*** and the list displayed shown in Figures 17 and 18.

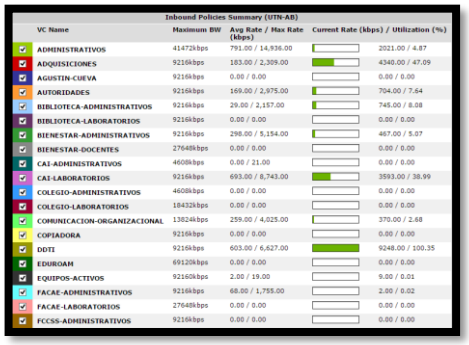

Figura 17. Lista de VLANs creadas en el equipo EXINDA. Extraído de EXINDA 4061 UTN.

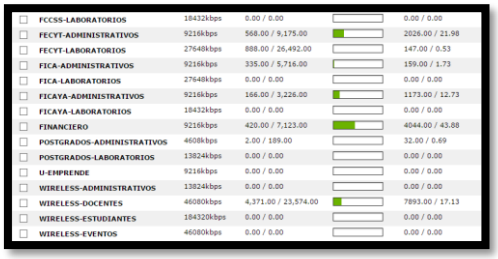

Figure 18. List of VLANs created on the Exinda team. Extracted from EXINDA 4061 UTN.

IV. CONCLUSIONS

When deploying segmentation bandwidth and optimization policies in the Exinda team, it has greatly improved network management data, allowing ensure users a predetermined bandwidth for Internet browsing, as It is to have a proper administration did not cause saturation allowing other VLANs work normally.

The investigation of the concepts of network segmentation, virtual local area networks, types of network traffic, helped the understanding of the operation of the data network and be able to more easily determine the needs of the same.

The description of the features and functionality of PacketShaper equipment, which was used for the study allowed a better interpretation of the data obtained in the analysis of consumption bandwidth applications.

For the realization of adequate bandwidth segmentation, university mansion purchased a new computer administrator bandwidth covering a licensing demand with total bandwidth of the university.

As a result of the study of the current situation of the data network of the Technical University of the North, it was determined that there was no adequate segmentation of bandwidth and this caused that their bottlenecks VLANs and a lousy network performance.

At the time of the study of consumption of bandwidth both VLANs and applications used by each of them, it was possible to obtain an estimated value of bandwidth required based on the needs and capabilities of each VLAN, as well as a review of the recommendation G.1010 which oriented in a way most appropriate segmentation bandwidth.

In performance tests it found that, based on the needs of the institution, for each unit can be changing the allocation of bandwidth, as the team allows oversizing in that assignment allowing better management.

It was determined that the benefit of the implementation team manager bandwidth Exinda is social, because by having this team can manage the network in the best way possible, ensuring the user a predetermined bandwidth for use.

This project ended with segmentation bandwidth to 450 Mbps, but now the institution made a new agreement with CEDIA and now has 600 Mbps bandwidth, but this does not create any inconvenience, since the allocation is based in percentages and not directly affect segmentation, should only make the change in the global circuit.

V. RECOMMENDATIONS

In the data network of the institution conducting constant monitoring of the network it is necessary, since the demand of users with each term increases, and it appears the need for new applications demanding increased consumption of bandwidth and possibly due to make an adjustment in the distribution of bandwidth.

The total distribution in an allocation of bandwidth over 1 Gb was determined to provide better service, because the computer allows for oversizing in the allocation. It is suggested to hire a greater band width, as this will optimize processes and services in the university house and take advantage of the licensing administrator Exinda bandwidth is 1 Gbps equipment.

Administrator bandwidth Exinda, among its features, team has to create policies for better optimizing the use of bandwidth, such as limiting bandwidth consumption in applications or blocking access to them, it is recommended that monitoring constant to determine which new policies can further optimize the bandwidth consumption.

For proper distribution of bandwidth to consider that the data network operates on Class of Service (CoS), allowing network administrators, determine the priority for traffic based on the importance of each agency or department within the data network.

REFERENCES

Acosta, A. (2 de Enero de 2010). *Como determinar/ calcular el ancho de banda para un enlace* . Obtenido de http://blog.acostasite.com/2010/01/como-determinarcalcular-el-ancho-de.html

AGOSTINI, F. (2001). *DESCRIPCION DE LOS ESTANDARES* . Obtenido de JAVA Y ACTIVEX: http://neutron.ing.ucv.ve/revista-e/No1/JAVACTIV.htm

Alegsa, L. (2 de Septiembre de 2009). *Definición de Skype.* Obtenido de http://www.alegsa.com.ar/Dic/skype.php

Alegsa, L. (12 de Mayo de 2010). *Definición de BitTorrent.* Obtenido de http://www.alegsa.com.ar/Dic/bittorrent.php

Apablaza, C. (2014). *RTSP Real Time Streaming Protocol.* Obtenido de http://profesores.elo.utfsm.cl/~agv/elo323/2s10/projects/ApablazaBustamante/desc.html

Apple. (28 de Abril de 2003). *Apple Press Info.* Obtenido de http://www.apple.com/pr/library/2003/04/28Apple-Launches-the-iTunes-Music-Store.html

Becerro, A. (2005). *Guia rápida de VNC.* Obtenido de http://www.elviajero.org/antoniux/tutos/vnc1.pdf

Beiro, J. (19 de Enero de 2009). *Aplicación – SHOUTcast Radio.* Obtenido de http://www.actualidadiphone.com/aplicacion-shoutcast-radio/

Delgado, C. (09 de Marzo de 2014). *Diferencias entre POP e IMAP*. Obtenido de http://www.christiandve.com/2014/03/diferencias-entre-pop-e-imap-correo-electronico-particularidades-gmail/

Descargar. (Mayo de 2011). *DESCRIPCIÓN DE AOL AIM.* Obtenido de http://descargar.traducegratis.com/es_soft_v_i27739/AOL-AIM.htm

Downsoft. (30 de Noviembre de 1999). *EarthStation5.* Obtenido de http://descargas.itespresso.es/windows/windows-internet/windows-p2p/earthstation5-1-1183.html

Microsoft. (2014). *Mejoras en la seguridad de DCOM.* Obtenido de MSDN: https://msdn.microsoft.com/es-es/library/cc738214(v=ws.10).aspx

Microsoft, S. (31 de Octubre de 2013). *Understanding the Remote Desktop Protocol (RDP).* Obtenido de https://support.microsoft.com/es-es/kb/186607

Oracle. (2011). *Uso de redes virtuales en Oracle Solaris 11.1* . Obtenido de ORACLE: https://docs.oracle.com/cd/E37929_01/html/E36563/gjzbf.html

Oracle. (Enero de 2014). *Oracle.* Obtenido de http://www.oracle.com/lad/corporate/press/pr-lad-31-jan-2014-2133385-esa.html

Padilla, J. (Agosto de 2015). *Modelado de flujo en redes.* Obtenido de http://jpadilla.docentes.upbbga.edu.co/Network_routing/10-Modelado%20de%20flujo%20en%20redes.pdf

Paspuel, D. (Julio de 2014). OPTIMIZACIÓN DEL ANCHO DE BANDA DE ACCESO A INTERNET . Ibarra.

Postel, J. (Mayo de 1983). *RFC 867.* Obtenido de http://www.networksorcery.com/enp/rfc/rfc867.txt

Quackenbush, G. (Octubre de 2005). *MPEG-1 Audio.* Obtenido de http://mpeg.chiariglione.org/standards/mpeg-1/audio

Quiroga, M. (29 de Enero de 2011). *Cómo funciona Internet: ¿Qué son y para qué sirven las DNS?* Obtenido de http://www.xatakaon.com/tecnologia-de-redes/como-funciona-internet-dns

Reyes, H. (Mayo de 2011). *Administración y Operación de Redes.* Obtenido de Cudi: http://www.cudi.edu.mx/primavera_2011/presentaciones/NOC_OpenSource_Hans.pdf

Author

Peralta Burbano Elsa Irene

She was born on February 17, 1991 in Santo Domingo de los Tsáchilas, completed his primary education at the Education Unit Inti Raymi, in 2008 obtained his Bachelor of Commerce and Administration Specialty Informatics, currently is a graduate of the School of Electronics and Communication Networks Universidad Técnica del Norte, holds the position of Coordinator IEEE Young Professionals in Ibarra.