



# **UNIVERSIDAD TÉCNICA DEL NORTE**

## **CARRERA DE INGENIERÍA EN ELECTRÓNICA Y REDES DE COMUNICACIÓN**

**SCIENTIFIC ARTICLE IEEE**

### **THEME:**

**SISTEMA DE VIDEOVIGILANCIA IP SOBRE UNA RED INALÁMBRICA  
BASADO EN EL ESTÁNDAR IEEE 802.11AC PARA LAS DEPENDENCIAS  
DEL GOBIERNO AUTÓNOMO DESCENTRALIZADO DE SAN MIGUEL DE  
URCUQUÍ.**

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# IP VIDEO SURVEILLANCE SYSTEM OVER WIRELESS NETWORK BASED ON IEEE 802.11ac STANDARD FOR GOVERNMENT DEPARTMENTS OF SAN MIGUEL AUTONOMOUS DECENTRALIZED URCUQUI

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**Abstract**—This research aims to design an IP video surveillance system, based on IEEE 802.11ac standard equipment for security to protect high risk areas of vulnerability of the “San Miguel de Urcuqui” Municipal Government wireless networks. The current project is covering more than cameras connected to a server, it is important to determine internal wireless network equipment, wireless links devices, network materials, electrical equipment, backup power equipment grounding, among others; all these components together allow that the mentioned project works better. There are several softwares, which let to have a suitable design, among the used programs; they have autocad for designing plans, Analyzer WI-FI to determine interference networking, IP Video System Design Tool for the architectural plans and location of cameras, Ekahau Heat Mapper, for levels of wireless network coverage. When a project is designed, it should be considered the cost / benefit factor of the project, although a project could be viable, but when there are not enough financial and human resources, the project can fail. In the benchmark cost-benefit analysis, a recovery period of 7 months and 15 days is determined finally, conclusions and recommendations based on all the problems and progress in the development of the project are presented.

## I. ANTECEDENTES

### A. Problem

Decentralized Autonomous Municipal Government of the canton San Miguel de Urcuquí (GADMU) located in the province of Imbabura, carries the surveillance of its dependencies an outdated and poorly due to lack of current systems. The GADMU has equipment: computer, didactic machinery, equipment and technological equipment; many of them of high economic and delicate value, distributed among some departments such as: The main building, library, mechanical, square of good living, cantonal council, cantonal board, Social Development Unit (patronage, pharmacy, doctor) and meeting adult majeure, which have existed resulting vulnerability to crime.

Surveillance at the main facility has two guards and other dependencies only one person working in them and is responsible for its control and being away without surveillance cameras are poorly supervised from the main department. In the main building, the guards monitor the entry and exit of people, but not control the activities of their employees, thus making long hours of surveillance and low monitoring facilities does not identify the possible perpetrators of a robbery or a

misconduct; because it does not have evidence through digital storage media, causing a delay in obtaining information and making decisions later for lack of evidence.

### B. Justification

At present nationwide, security and surveillance has increased greatly with technological assistance, as is the use of safety systems using IP technology. The present government has implemented programs to improve public safety, among them is "The comprehensive safety plan", "GOOD NATIONAL PLAN TO LIVE", which are focused on the welfare of human beings so this project is channeled these programs; without forgetting that the project focuses on promoting social development and technological innovation as a fundamental part of the mission of the Technical University of the North.

The design of an IP Video Surveillance System over a wireless network based on the IEEE 802.11ac standard for government agencies Autonomous Decentralized San Miguel de Urcuquí, enable, monitor and protect, locally and remotely its main facility and external facilities, whereby you can prevent crimes and identify the perpetrators of illegal actions committed or improper behavior. In addition to keeping track in real time only with an internet connection, you can ensure efficient work of its employees.

This system will also monitor the different offices, especially to the public, allowing proper execution of functions, schedules and habits, helping to improve staff performance and therefore the institution. IP video surveillance has created a security application that goes beyond any of the technologies available, and is highly scalable, providing high degree of functionality, it provides observation 24 hours a day all sites that look vulnerable to insecurity.

## II. THEORETICAL FOUNDATION

### A. IP Video Surveillance System

A video surveillance system in a set of elements that interact with each other. "The video surveillance cameras is to install video over a network, which recorded and stored on a digital recorder or look in real time from a central monitor" (Garcia, s.f, p. 11).

## B. Video Management System

An important aspect of a video surveillance system is managing video, which consists of a set of elements that allow proper control of the video provided by video surveillance cameras; among these, we are display, recording, playback and storage live.

## C. Means of Transmission

The transmission medium is the channel for transmitting information between two or more terminals. The transmission is performed by means of electromagnetic waves propagating through the channel. Sometimes for transmitting, a physical channel is used or guided and sometimes that is not unguided. (NOGUERA & VÁSQUEZ, 2011, p. 150).

## D. Wireless Networks

Wireless networks are technologies that increase productivity for today's professionals, as they can stay connected anytime, anywhere. Among the most important advantages is the affordability because it eliminates or reduces costs structured cabling allows easy installation and expansion, gains access to network resources from any location within the coverage areas (TANEMBAUM, 1997, p. 200).

## E. Radio Links

Radio links are connections between different telecommunications equipment using electromagnetic waves. Wireless links offer the ability to connect to the Internet inaccessible places where there are no other possibilities of telecommunications services.

## F. Security of Wireless Network

Security in a wireless network, is the most important and often forgotten and because of several problems (Monteros, 2015, p. 56). Therefore, security policies that help provide network security arise.

## G. Power System UPS

The uninterruptible power supply or UPS (acronym uninterruptible power supply), is a device that thanks to batteries or other storage elements energy can provide power to the devices connected to it, for a limited time during a power failure energy.

# III. SYSTEM DESIGN IP VIDEO SURVEILLANCE

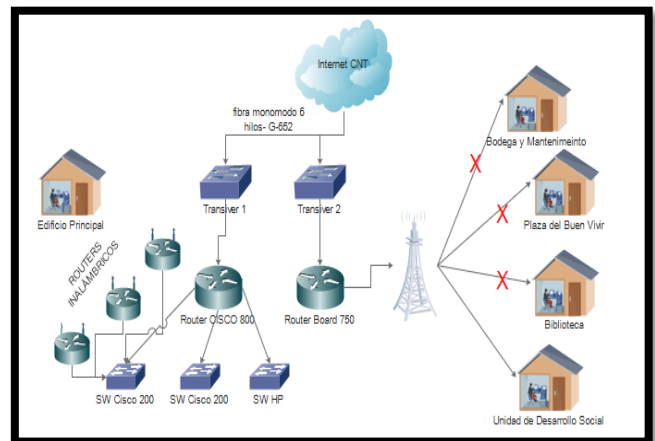
## A. Wireless Network Topology

The contract GADMUR internet service to the company CNT, this comes with single mode optical fiber at two transceivers

The first transceiver reaches a Cisco router 800 in this team three terminals are connected: the first is connected to an HP server is disabled, the second is connected to multiple switch cascading for connection to the network of different users and the third is connected to a router which is connected to three Access Point that is responsible for providing wireless internet, however APs above were placed without prior study. The second transceiver, connects to a router BOARD 750, this is connected to an antenna located on the terrace of the facilities and provide internet allows external dependencies.

Wireless links that were made previously stopped working except the link to the reliance on Social Development Unit "Eugenio Espejo" and has not taken the initiative to restore this service. The link that arrives from the main building to dependence on social development, reaches a Switch and this connects two computers, there is no wireless or wired network despite the various offices located within the premises.

In Figure 1, the topology of the wireless network GADMUR shown.



**Figure 1.** Wireless Network topology GADMUR  
Source: Made by myself

## B. Analysis Site Survey

When driving on an analysis site, the following steps are performed:

### 1. Study area

For each area GADMUR first be discussed in detail design, for which you must have your updated detailed drawings and Autocad.

### 2. Visual inspection

Once printed flat area, a detailed inspection of each area will be to verify the accuracy of plans and detect any irregularities, existing sources of signals, dead zones, and barriers to the spread of wireless signals.

### 3. Identification of areas to provide coverage

In this step, you need to identify the areas where it is intended to cover the wireless network, taking into account the areas where there is more affluence of users, areas where the installation of wireless equipment and spaces possible where not required to have coverage.

4. **Identify areas where potential problems may exist**

It is very important to analyze spaces where there may be obstacles preventing the signal from the wireless equipment will be received by users and the system that is being installed or that may be affecting network interference.

5. **Analysis of the possible location of the equipment: access points and antennas.**

The possible location of equipment depending on the areas requiring cover taking into account accessibility for installing them may be determined.

6. **Document results**

It is very important that the results are documented in the form of summary of activities or graphically with the analysis of the plans and the help of software that helps in Site Survey.

C. *Location of cameras and APs in each unit*

In Figure 2, the location of the cameras covering the AP\_EP1 and coverage will each if the AP, is placed on that site is shown.

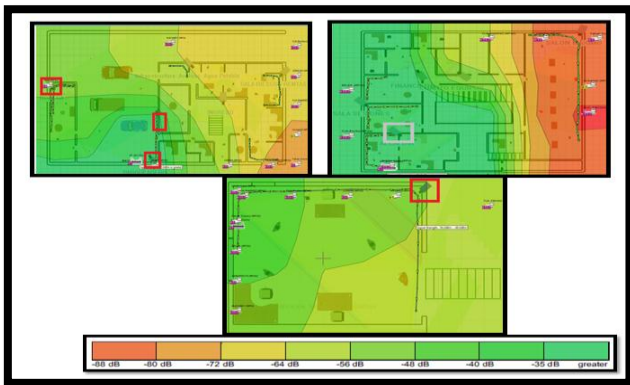


Figure 2. Areas of coverage for the Main Building AP\_EP1  
Source: Made by myself

In Figure 3, the location of the cameras covering the AP\_EP2 and coverage will each if the AP, is placed on that site is shown.

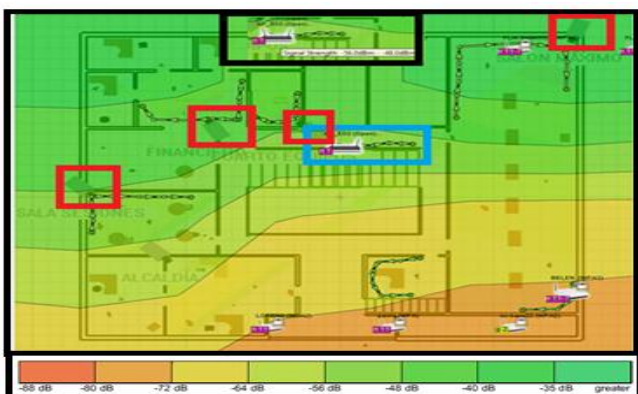


Figure 3. Areas of coverage for the Main Building AP\_EP2  
Source: Made by myself

In Figure 4, the location of the cameras covering the AP\_Ep3 and coverage will each if the AP, is placed on that site is shown.

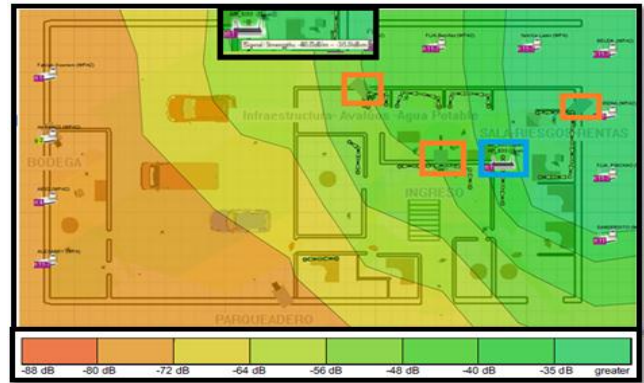


Figure 4. Areas of coverage for the Main Building AP\_EP3  
Source: Made by myself

In Figure 5, the location of the cameras covering the AP\_B1 in dependence Library and coverage will each if the AP\_B1, are placed on that site is displayed.

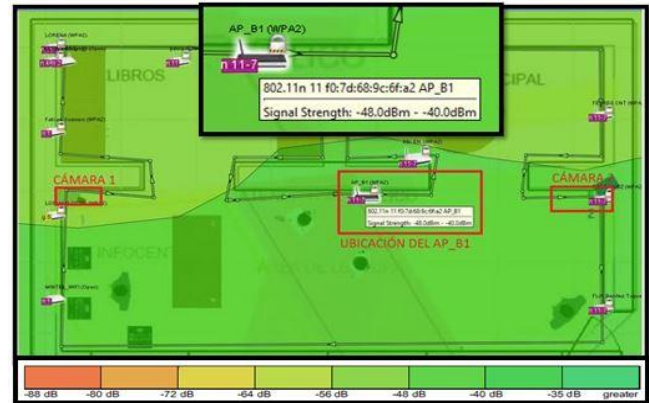


Figure 5. AP coverage areas for the Library B1  
Source: Made by myself

In Figure 6, the location of the cameras covering the AP\_M1 in Mechanical dependency and coverage will each if the AP\_M1, is placed on that site is displayed.

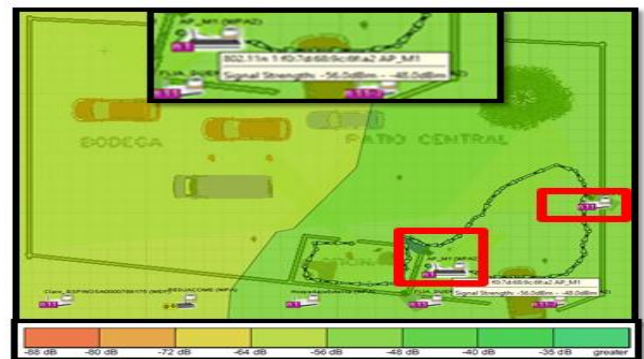
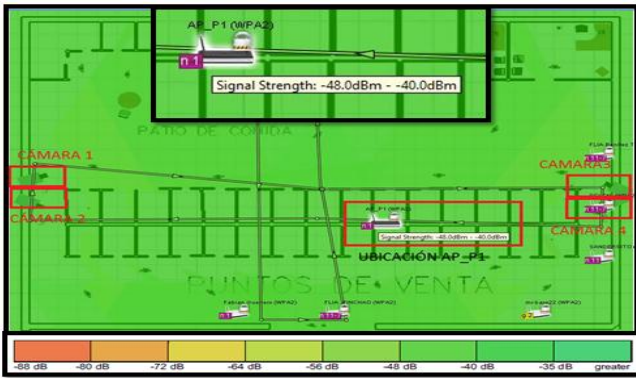
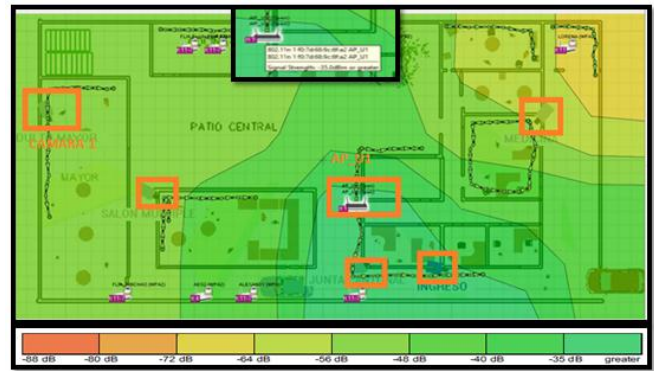


Figure 6. Areas of coverage for Mechanics AP M1.  
Source: Made by myself

In Figure 7, the location of the cameras covering the AP\_P1 in dependence Plaza del Buen Vivir and coverage will each if the AP\_P1, is placed on that site is displayed.



**Figure 7.** Areas of coverage P. AP\_P1 for Good Living.  
**Source:** Made by myself



**Figure 8.** Areas of coverage for Mechanics AP M1.  
**Source:** Made by myself

In Figure 8, the location of the cameras covering the AP\_P1 in dependence U. Social Development and the coverage will each if the AP\_U1, is placed on that site is displayed.

**D. Links between Main Building and External Dependencies**

For interconnection between the main building and outbuildings, a link point will be used - multipoint, which ensure communication between them and the proper system performance video surveillance, the transmitter will be located in the main building and receivers will be installed in other units. In Table 1, the data necessary for calculating detailed radio link.

**Table 1.** Data For calculating Radio Link

DATA	VALUE FOR UNITS			
	BIBL	MANT	PLAZ	UNID
Operating Frequency (f) [GHz]	5.8 GHz			
Link Distance (D) [Km]	0,31[Km]	0,24[Km]	0,35[Km]	0,26[Km]
Link Distance in Miles [millas]	0,193[mi]	0,149[mi]	0,217[mi]	0,162[mi]
Distance from the transmitter to the object interfering (d1) [Km]	0,12[Km]	0,08[Km]	0,12[Km]	0,12[Km]
Distance from the receiver to the object interfering (d2) [Km]	0,04[Km]	0,08[Km]	0,02[Km]	0,04[Km]
Height of the main building + the height of the transmitting antenna (h1) [m]	8			
Secondary building height + height of the receiving antenna (h2) [m]	6 [m]	8 [m]	7 [m]	8 [m]
More interfering building height (hc) [m]	5[m]	5 [m]	6 [m]	6 [m]
Pin [dbm]	20[dBm]	20[dBm]	20[dBm]	20[dBm]
Radio Earth [Km]	6378			

**Source:** Made by myself

Table 2 summarizes the results of calculations of the first Fresnel zone, whether they were performed manually as those performed with the Mobile Radio Software exposed also it concludes that the results are roughly similar, and the difference is minimal error of 9% .Radio land.

**Table 2.** Results of calculations of the First Fresnel Zone

Dependence	First First Fresnel Zone	Fresnel zone (Radio Mobile)
Biblioteca	0,96 [m]	0,9 [m]
Plaza del buen Vivir	0,64 [m]	0,6 [m]
Unidad de desarrollo Social	1,05 [m]	1,2[m]
Mantenimiento	1,26 [m]	1,4 [m]

**Source:** Made by myself



Table 3 summarizes the results of calculations of the height clearance, whether they were performed manually as those performed with the Mobile Radio Software exposed also it concludes that the results are roughly similar, and difference is minimal error of 0.6%.

**Table 3: Calculation Results Clearance Zone**

Dependence	Zona de Despeje (Cálculos)	Zona de Despeje (Radio Mobile)
Biblioteca	2,23 [m]	2,21 [m]
Plaza del buen Vivir	1,66 [m]	1,66 [m]
Unidad de desarrollo Social	2 [m]	2,01 [m]
Mantenimiento	3[m]	3,05 [m]

Source: Made by myself

Table 4 summarizes the results obtained by applying the formula shown. We note further that the percentages meet the specified value that determines that these values should at least have 60% clearance.

**Table 4: Percentage Calculation Results Clearance**

Dependence	Porcentaje de Despeje
Biblioteca	231,86%
Plaza del buen Vivir	258,90 %
Unidad de desarrollo Social	190,47 %
Mantenimiento	237,34 %

Source: Made by myself

Table 5 summarizes the results of calculations Attenuation is exposed by free space, whether they were performed manually as those performed with the Software Radio Mobile, also it concludes that the results are roughly similar, and difference is minimal error of 0.6%.

**Table 5: Calculation Results Attenuation by free space**

Dependence	Atenuación por espacio Libre	Atenuación por espacio Libre (Radio Mobile)
Biblioteca	97, 54 [dB]	97, 5[dB]
Plaza del buen Vivir	98, 59 [dB]	98, 5 [dB]
Unidad de desarrollo Social	94,73 [dB]	95,9 [dB]
Mantenimiento	94, 03 [dB]	95,2 [dB]

Source: Made by myself

Table 6 summarizes the results obtained by applying the formula and using the Radio Mobile software is shown, it is noteworthy that one of the most important values is the level reception power in dBm, the lower the better quality will have the link, ideally be between -40 and -80 dBm.

As shown the results determined that the link quality is adequate and both the calculations and the software used a margin of error of 0.5% occurs.

**Table 6: Power Calculation Results Receiving Free**

Dependence	Potencia de Rx cálculos	Potencia de Rx
Biblioteca	-45,84 [dBm]	-45,8 [dBm]
Plaza del buen Vivir	-46,89 [dBm]	-46,9 [dBm]
Unidad de desarrollo Social	-43,03 [dBm]	-42,8 [dBm]
Mantenimiento	-42,33 [dBm]	-42,33 [dBm]

Source: Made by myself

Table 7 summarizes the results of calculations of fade margin, whether they were performed manually as those performed with the Software Radio Mobile with a margin of error of 12% is exposed.

**Table 7: Calculation results of fade margin**

Dependence	Margen de	
	Desvanecimiento	Desvanecimiento Radio Mobile
Biblioteca	46,20 [dB]	42,26 [dB]
Plaza del buen Vivir	45,10 [dB]	38,26 [dB]
Unidad de desarrollo Social	48,97 [dB]	41,65 [dB]
Mantenimiento	49,67 [dB]	41,69 [dB]

Source: Made by myself

Table 8 summarizes the results obtained by applying the formula shown link unavailability.

**Table 8: Calculation Results Reliability of Link**

Dependence	Confiabilidad del Enlace
Biblioteca	99.99%
Plaza del buen Vivir	99.97%
Unidad de desarrollo Social	99.98%
Mantenimiento	99.98%

Source: Made by myself

Table 9 summarizes the results obtained by applying the equation and verify link unavailability shown.

**Table 9: Results link availability calculation**

Dependence	Indisponibilidad del Enlace min/año
Biblioteca	52,56 min/año
Plaza del buen Vivir	157,68 min/año
Unidad de desarrollo Social	105,12 min/año
Mantenimiento	105,12 min/año

Source: Made by myself

#### A. Software de Gestión de Cámaras y Video

The Zoneminder program is free software, well known for managing surveillance cameras, the same as working on similar operating systems to Linux, working independently and

limit thus unnecessary consumption of resources and maximizing efficiency a computer. Zoneminder, allows capture, analysis, recording, video monitoring, among others; also has a number of configurable parameters, such as sending e cameras, etc. Its distribution is licensed under the GPL (General Public License), which means it is a free software, which allows distribute free of charge. In Figure 9, the program logo appears.

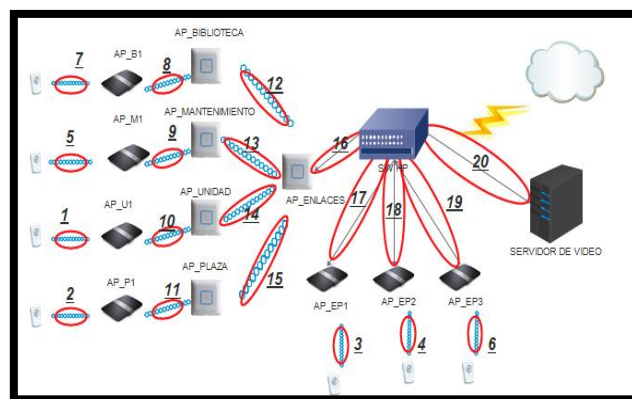
### B. Internet y Acceso Remoto

The Municipal GAD Urcuqui hires CNT bandwidth of 12 [Mbps] rise and 16 [Mbps] down, which 6Mbps which are arranged between all services, and the remaining 6Mbps these available for use if you want to deploy the video surveillance system.

### C. Direccionamiento IP

For the network that is designed segment 172.16.5.0 IP address is used to mask 255.255.255.0

To make addressing considering the number of equipment to be used. Below in Figure 10, the network topology to be designed is shown, plus the corresponding subnets.



**Figura 101: Topología de Red a Diseñarse**  
Source: Made by myself

**Table 10: IP Addressing**

subred	Host	Host permitidos	#bits	#bits restantes	IP RED	1ra IP válida	Última IP válida	broadcast	Máscara	/
1	5	8	6	2	172.16.5.0	172.16.5.1	172.16.5.6	172.16.5.7	255.255.255.192	26
2	4	8	6	2	172.16.5.8	172.16.5.9	172.16.5.14	172.16.5.15	255.255.255.192	26
3	4	8	6	2	172.16.5.16	172.16.5.17	172.16.5.23	172.16.5.24	255.255.255.192	26
4	4	8	6	2	172.16.5.24	172.16.5.25	172.16.5.30	172.16.5.31	255.255.255.192	26
5	3	8	6	2	172.16.5.32	172.16.5.33	172.16.5.38	172.16.5.39	255.255.255.192	26
6	3	8	6	2	172.16.5.40	172.16.5.41	172.16.5.46	172.16.5.47	255.255.255.192	26
7	2	4	2	6	172.16.5.48	172.16.5.49	172.16.5.50	172.16.5.51	255.255.255.192	26
8	2	4	2	6	172.16.5.52	172.16.5.53	172.16.5.54	172.16.5.55	255.255.255.252	30
9	2	4	2	6	172.16.5.54	172.16.5.55	172.16.5.58	172.16.5.59	255.255.255.252	30
10	2	4	2	6	172.16.5.56	172.16.5.57	172.16.5.62	172.16.5.63	255.255.255.252	30
11	2	4	2	6	172.16.5.58	172.16.5.59	172.16.5.66	172.16.5.67	255.255.255.252	30
12	2	4	2	6	172.16.5.60	172.16.5.61	172.16.5.70	172.16.5.71	255.255.255.252	30
13	2	4	2	6	172.16.5.62	172.16.5.63	172.16.5.74	172.16.5.75	255.255.255.252	30
14	2	4	2	6	172.16.5.64	172.16.5.65	172.16.5.78	172.16.5.79	255.255.255.252	30
15	2	4	2	6	172.16.5.66	172.16.5.67	172.16.5.82	172.16.5.83	255.255.255.252	30
16	2	4	2	6	172.16.5.68	172.16.5.69	172.16.5.86	172.16.5.87	255.255.255.252	30
17	2	4	2	6	172.16.5.70	172.16.5.71	172.16.5.90	172.16.5.91	255.255.255.252	30
18	2	4	2	6	172.16.5.72	172.16.5.73	172.16.5.94	172.16.5.95	255.255.255.252	30
19	2	4	2	6	172.16.5.74	172.16.5.75	172.16.5.98	172.16.5.99	255.255.255.252	30
20	2	4	2	6	172.16.5.76	172.16.5.77	172.16.5.102	172.16.5.103	255.255.255.252	30

Source: Made by myself

### D. Diagram IP Video Surveillance System

After all calculations, analysis, among others; system design is presented as follows.

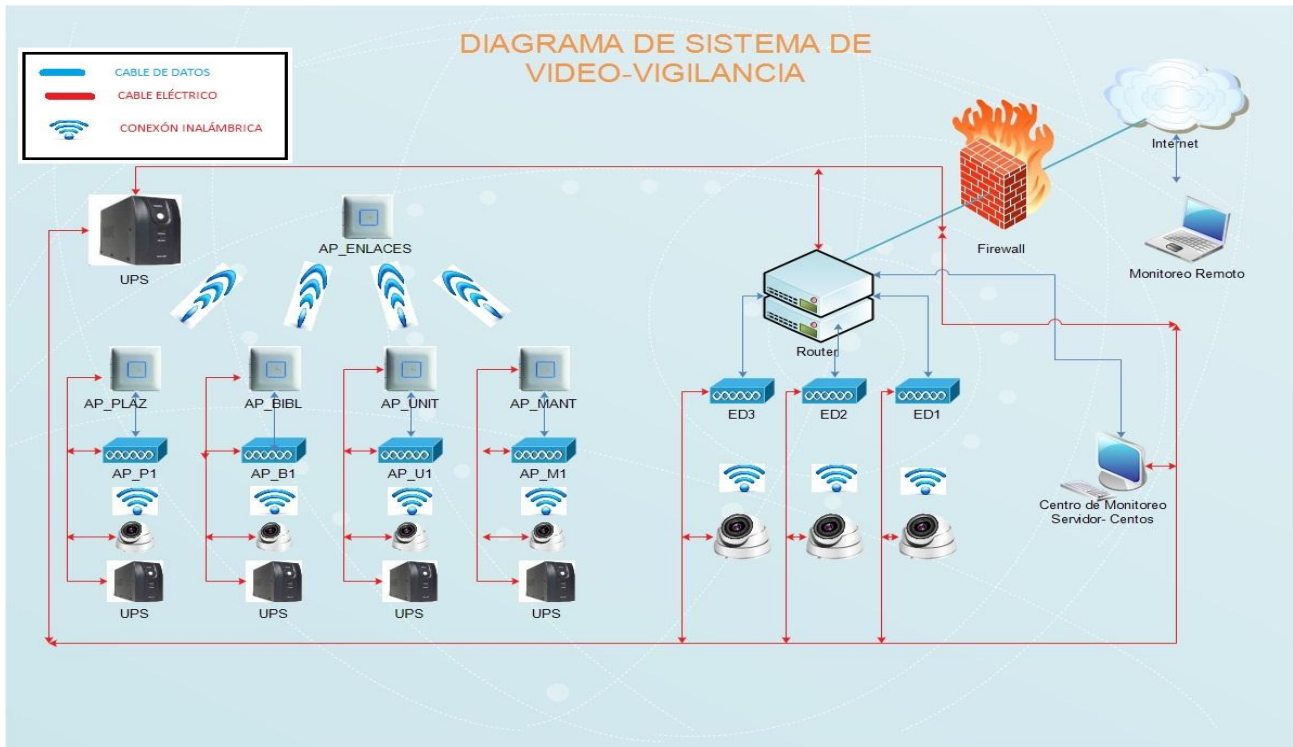


Figura 11: Diagrama del Sistema de Video Vigilancia  
Source: Made by myself

#### IV. ANÁLISIS COSTO BENEFICIO

Here is a reference budget of equipment and resources needed for a possible installation and operation of video surveillance system is presented. It is emphasized that the values shown are only for reference and determine the project cost.

##### A. Equipment Costing

Table 11 shows that the sum of costs

Table 11: Total costs of video surveillance system

DESCRIPCIÓN	COSTO
Costo de equipos red inalámbrica interna	11,242,47
Costo de equipos para radioenlaces	1097,60
Costo de material de red	817,71
Costo de material eléctrico	96,32
Costo mano de obra	320,00
<b>TOTAL</b>	<b>13,574,10</b>

Source: Made by myself

##### B. Determination of benefits

Currently the institution has 5 security guards, which are distributed as follows: Plaza del buen vivir two guards, a guard Maintenance and the main building two guards. If taken into account, the Unit for Social Development and Library, has no security of any kind; Another very important point is security personnel, works 8 hours a day so the facilities are unprotected at night.

To determine the benefits is determined that each guard has a basic salary of \$ 366 and the 7 existing guards at the

moment and by hiring only service two of them will be needed, if the system fails in this case is counted Safely; the following equation applies:

$$5(\text{guardias}) \times 366 \frac{\text{dólares}}{\text{mes}} \times 12 \text{ meses} = 21,960,00 \frac{\text{dólares}}{\text{año}}$$

##### C. Calculation Cost / Benefit

After analyzing the costs and benefits generated by the project, we apply the equation to determine the cost / benefit, for which the following parameters were used:

$$\frac{B}{C} = \frac{\Sigma \text{Beneficios}}{\Sigma \text{Costos}}$$

Ecuación 1: Cálculo del Beneficio/Costo

Fuente: [1]

$$\frac{B}{C} = \frac{21\,960,00}{13\,574,10} = 1,62$$

By applying the equation the value is 1.62; so it is determined that the project is acceptable.

##### D. Disclosure Project Period

Table 12, is applied to determine which month the investment is recovered, however, to have a more precise time period equation applies.



**Table 12: Payback**

MES	BENEFICIO / MES	BENEFICIO / AÑO
0		-13 574,10
1	1830,00	1830,00
2	1830,00	3660,00
3	1830,00	5490,00
4	1830,00	7320,00
5	1830,00	9150,00
6	1830,00	10,980,00
7	1830,00	12,810,00
8	1830,00	14,640,00

**Nota:** el beneficio mensual se obtiene multiplicando los 5 guardias que laboran en la institución por su salario mensual de \$ 366.

**Source:** Made by myself

Período \_recuperación= 7 meses + 15 días

These calculations show that a period of payback of 7 months and 15 days will.

## E. CONCLUSIONS

- Wireless signals present problems of interference and signal loss, either by physical objects such as walls or nearby wireless networks; however, if you do not have a suitable structured wiring and do not want to damage the visual aesthetics of the facility, this type of wireless technology is a good application. In addition there have been technological advances such as 802.11ac, which can send information at high speeds and with rapid synchronization.
- The current situation GADMUR network infrastructure is poor, to the point that several external agencies do not have wireless network and much less are connected to the central building to be controlled; Moreover several vulnerable areas influx of people, teams risk of high economic value and strategic sites for public employees control was determined. With these data, the minimum requirements for easily system design is obtained.
- A video surveillance system covers several components such as equipment for internal wireless network equipment for wireless links, network materials, electrical equipment, backup power equipment, grounding, among others; all these components together allow the system to operate properly
- The design of radio links, is based in coverage between two points, being important to have line of sight otherwise would be impossible communication between them. Radio links simulators allow data to work with real equipment and also help inform design, allow to obtain almost real data, avoiding wasting time and money by implementing radio links without being sure of its feasibility. Design for the Radio Mobile software and manual calculations used and to compare these results an error of 4.5% is obtained and thus concluded that the software offers a high degree of reliability.
- comparing mikrotik for radio equipment and ubiquiti was performed and using ubiquiti 802.11ac routers because

they offer an economic technology, but with high potential in the management of networks was considered, allowing you to manage bandwidth easily through a friendly visual interface.

- The monitoring equipment such as cameras and routers are low power consumption so that they can operate 24 hours a day, 7 days a week, without this representing a considerable increase in the payment of the forms of electricity consumption the institution.
- The project designed, has great benefits when its implementation will not need to hire security overstaffed which presents an annual savings of \$ 21,960.00 for an investment of 13,574.10. In addition, the time required to bear the cost of the project is 7 months and 15 days ..

## RECOMMENDATIONS

- The costs of equipment used in the design are referential, so if you plan to install after a while, it is recommended that information on the costs of that moment and take that data to the purchase of equipment.
- It is recommended that to present some kind of problem with IP cameras and are intended to replace take into account whether the camera was in a zone external environment, or internal and replaced them with this parameter to the team has no problems with the environmental conditions to which they are exposed.
- Facilities GADMU, have a grounding, but it is recommended that at least once in the driest time of year resistance grounding is reviewed and soil resistivity is measured as several teams connect to it, including video surveillance system designed and should not suffer any electrical problem, otherwise, the security of the institution would be compromised and suffer damage if the teams would incur large costs for equipment damage.
- To design WLANs is important to consider the securities to be used so that the network can not be affected physically and logically. There are methods of encryption, IP address filter, MAC filters and firewall; which will allow prevent network attacks.
- The video server, the UPS equipment must be in a cool place (18 ° C to 24 ° C) and if possible with adequate ventilation to prevent overheating problems.
- In recommended the implementation of security policies and assigning passwords for both access videos stored, as for the videos that are transmitted in real time to avoid running the risk that malicious people have access to these videos and make misuse them.
- It is recommended that a technical maintenance UPS equipment every year, which sewed in testing time power backup, check the connectors of the internal battery, check the status of the batteries so there is no leakage of chemical liquid, among others.

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