"REENGINEERING OF MUNICIPAL GAD NETWORK INFRASTRUCTURE OF OTAVALO, A DESIGN OF POINTS OF VOICE AND DATA, AND A DATA CENTER BASED ON THE STANDARD INTERNATIONAL ICREA-STD-131-2013 (MAY 2016)"

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Overview - the technology and all the benefits that are underlying the same, are indispensable tool that should expedite, modernize and improve the services offered on it. The existence of a structured cabling and certified equipment Center enable these services and it is very important in any public or private organization wishing to have a reliable, reliable network and is always available.

With this basis rests a reengineering of structured cabling design using the guidelines of the standard TIA/EIA-568-C for subsystems: work area wiring vertical and horizontal; wiring also presents a design of a Data Center under the Mexican norm ICREA-STD-131-2013 complying with the requirements of a level I data processing room systems: field, electrical installations, air conditioning, security and communications.

I. INTRODUCTION

The Autonomous decentralized Municipal Government of Otavalo (GADMO) provides services of telecommunications not only within the premises of the municipality, but also to citizenship both in urban and in rural areas. It was initially structured wiring Category 5e but with the passage of the years has migrated a part of wiring to category 6; Similarly to satisfy the needs of the local network LAN[1] have acquired modern equipment that has improved the performance of the network.

Currently in the municipal network, due to the increase of areas of work and relocation of staff not provided. More than five years ago was a redesign to the GADMO infrastructure causing the installation of structured cabling (CE) category 6 representing approximately, this new facility, 30% of the total network cabling; but there is still a large part of the network with Category 5e which does not meet the basic guidelines of ANSI[2] /TIA[3] /EIA[4] - 568-B.2 CE causing problems in the documentation and proper identification of network points, further problems in the internal network as large delays and inefficiency. For another side, there are two rooms of computers that do not fulfill the standards for proper operation, and likewise there is no adequate control for the entry of people, this is a great inconvenience, as this creates insecurity in the network of data.

For these reasons, it is necessary to propose a study of reengineering the data network, to optimize the existing network equipment through a redesign logic level, posing a hierarchical model of the network infrastructure; also must conduct an analysis of the network at the physical level to determine the current state of network infrastructure, a study of growth in work areas; propose a design point the location of voice and data and equipment room, analyzing the needs of users and based on this, enhance the performance of each of the services.

II. CURRENT SITUATION ANALYSIS OF NETWORK GADMO

A. General description of the structured cabling

For the process of gathering information from the structured wiring (CE) of the physical network, taken into account the following subsystems of the EC: work area, horizontal, vertical, and equipment

[1] LAN: Local Area Network

[2] ANSI: American National Standards Institute
[3] TIA: Telecomunications Industries Association
[4] EIA: Electronics Industry Association

room.

In *table I*, it is observed that total was 88 points of network, of which 18 points passed certification, as shown in the previous figure, representing only 21%; while the 70 remaining points not passed certification representing 79% which is more than half of the certified total points.

B. Room's equipment

Section electrical systems that power computer equipment and communications, their corresponding support devices and accessories equipment room have a separate power supply which is supplied from the general board that distributes the power grid to the building of the municipality.

The CPD currently has two systems of air conditioning one of Innovair-Vexus brand and other brand LG. These equipment are comfort; but for a quarter of equipment precision equipment are needed.

There is a fire and movement detector brand Bosch, with detection of strobe lights, water sensor sensor of low temperatures, with advanced reduction of false alarms; thus fulfilling the minimum requirements of security.

In 2009 the company Sinfotecnia made the installation of the telecommunications room; but from that year until now, they have been updating and increasing a number of active elements, below are the list of servers and current active equipment existing in the CPD, in *table II.*

Although there is no moisture tightness within the CPD and dust as there is a window which is not according to the standard from previously studied. The equipment room has ceiling with plates of mineral fibers, which is a material with high acoustic performance, high moisture resistance, stability, durability and fire behaviour. Furthermore you do not have false floor through which pass the electrical raceway and communications.

TABLE I
GADMO OVERVIEW OF CERTIFICATION OF THE GADMO NETWORK POINTS

DIRECCIÓN	***PASS CERTIFICATION***	***NO PASS CERTIFICATION***	***POINTS CERTIFICATES***
Auditoría Interna	1	4	5
Avalúos y Catastros	3	14	17
Bodega	0	2	2
Comisaría de Construcciones	1	2	3
Dirección de Fiscalización	0	4	4
Dirección de Gestión de Riesgos	2	2	4
Dirección de Gestión Ambiental	3	15	18
Informática y conectividad	3	5	8
Dirección de Planificación Territorial y Proyectos	2	7	9
Sala de Sesiones	1	6	7
Topografía	1	4	5
Tránsito y Transporte	1	2	3
TOTAL	**18**	**70**	**88**

Note: the information in the table was made by the author

TABLE II
OVERVIEW OF ACTIVE GADMO - CPD EQUIPMENT LOCATED ON THE TERRACE

UBICACIÓN	MARCA	SERIE	ESTADO
Rack – Wall	Switch 3Com	2928	Operating
	Switch 3Com	2928	Operating
Rack - floor # 1	Switch Cisco	3850	Operating
	Switch 3Com	4500G	Operating
Rack - floor # 2	Switch Hp	JD377A	Operating
	Switch 3Com	2928	Operating
	Switch 3Com	2924	Operating
	Switch 3Com	2452	Operating
	Switch D-Link	DGS-1008D	Operating
Rack - floor # 3	Router Cisco	800	Operating
	Router Cisco	800	Operating
Rack - Closet # 2	Switch Cisco	1941	Operating

Note: the information in the table was made by the author

III. Design of Physical Infrastructure Network and Data Center of GADMO

A. *Structured cabling*

The study projected growth is essential for the proposed data network design.

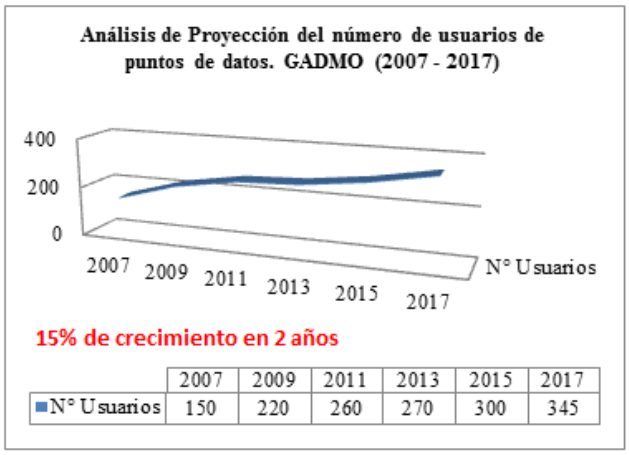

FIGURE I
STUDY POINTS GROWTH PROJECTIONS NETWORK
Source: Ing. Luis López GADMO

As can be observed in Figure I, around the year 2007 a total of 150 data points had, in 2009 there were 220 data points, for 2011 there were 260 data points, in 2013 about 270 points of data. He currently has 300 points of data between used and unused.

1) Vertical Cabling: Within GADMO facilities may be considered five links. We recommend using OM4 fiber optic links that provide interconnection facilities in the municipality. The central point is the CPD, located on the terrace which is a fiber optic link that connects via vertical cabling to the main building in the four nodes and the current node located in building 2. The distribution of vertical cabling is detailed in *figure II.*

2) Horizontal wiring: Knowing that the horizontal cable runs from the node to the work area; for design the next distribution must be implemented in a star topology type occurs. This structure is designed to be able to handle voice, data and video. Each work area must be connected to a corresponding node as shown in *Figure III.*

3) Justification for the category of structured cabling network requires: To select the category of structured cabling must analyse the type of service, applications and data to be carried by the network; in this case the EC will provide the IP telephony service, considering the existence of a telephone backbone between buildings is located in the equipment room of the terrace GADMO infrastructure. Analysing characteristics of bandwidth, maximum transmission rate, etc. it is decided to use for the design category 6A cabling or also known as Class EA. In addition to this category it is met the requirement of bandwidth for the transmission of IP telephony and maximum distances of horizontal cabling; that is done in real time, so there can be no packet loss and delays in communication and scalability wiring guaranteed 15 years.

4) Calculation of cable Cabling: A summary is shown in Table III, the number of category 6A cable rolls used.

TABLE III
NUMBER OF ROLLS CABLE UTP CAT. 6ª

UBICATION	BOXES [u]
Top floor	25
Ground floor	10
Building 2	2
TOTAL	**37**

Note: the author's own research

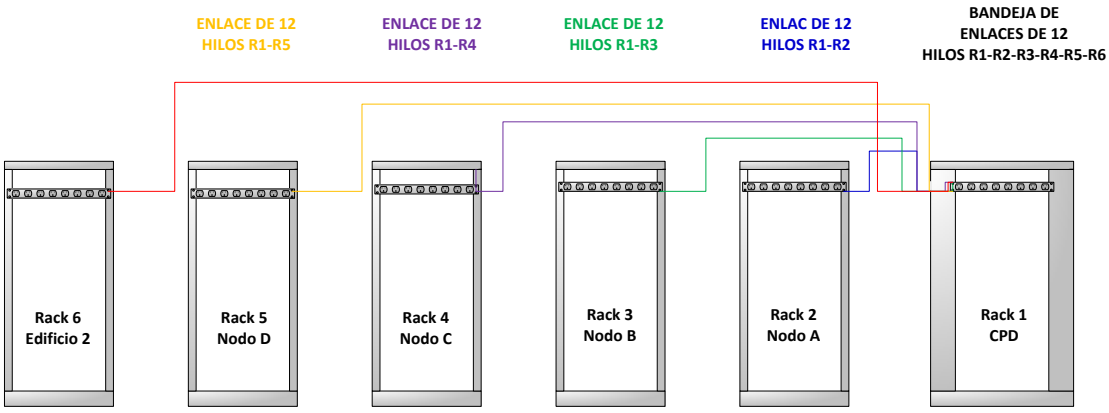

FIGURE II
VERTICAL WIRED NETWORK
Source: Prepared by the author

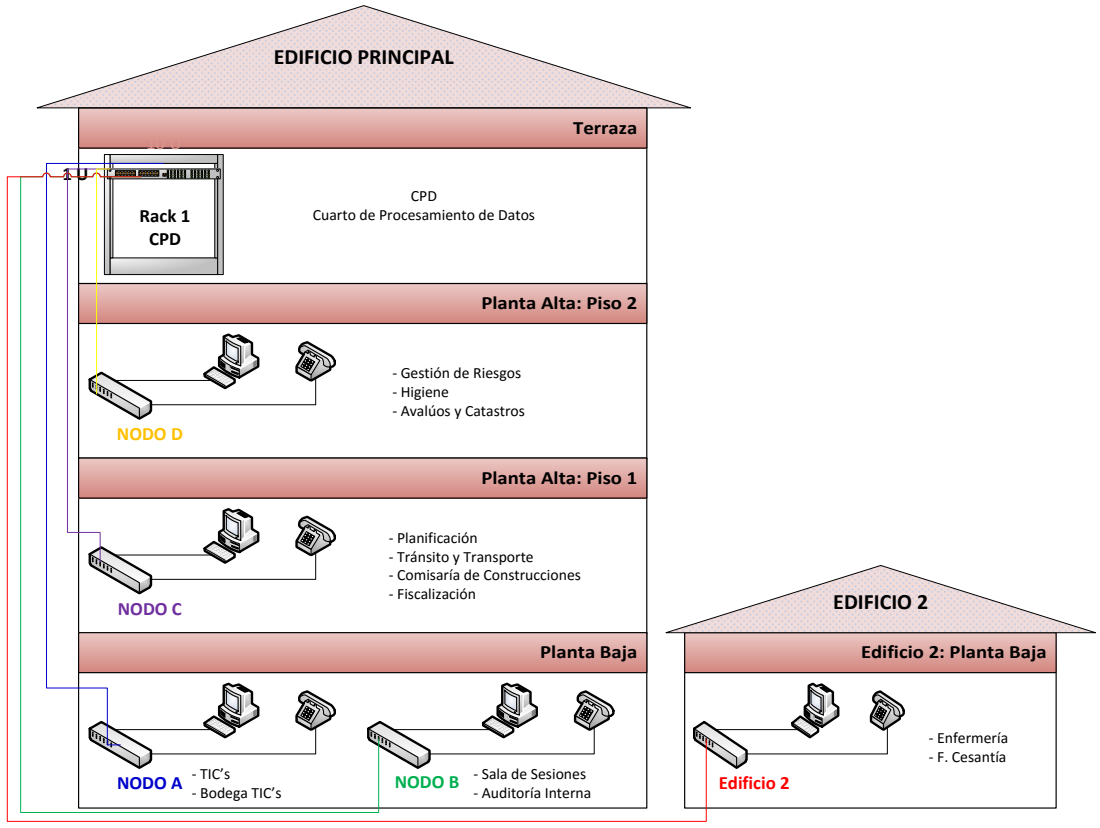

FIGURE III
HORIZONTAL CABLING
Source: Prepared by the author

B. *Room Data Processing*

1) Ambit: The dimensions of CPD for design are 6 [m] long by 4.40 [m] wide, resulting in a total area of 4.26 [m2], and which criteria sealing CPD must have a regular shape, is a square or rectangle.

The dimensions of the entrance door staff will be: 0.90 [m] and 2.30 [m] tall (figure IV). You must have an electromagnetic lock out and should abate; The door material is metal (non-combustible). Finishes not have texture to prevent dust accumulation. The paints used on the exterior walls of the CPD must protect them from fire in case of fire outside. No fuel element used in the internal or

external finishes.

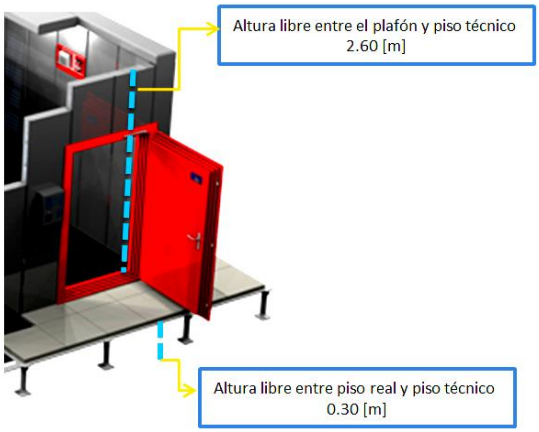

FIGURE IV
DISTANCE BETWEEN SKY AND FLOOR TRUE
Source: Prepared by the author

The dimensions of the entrance door staff will be: 0.90 [m] and 2.30 [m] tall. You must have an electromagnetic lock out and should abate; the door material is metal (non-combustible).

Due to technical floor should provide an access ramp with an inclination of 12 degrees with anti-slip cover material safety of access communications room.

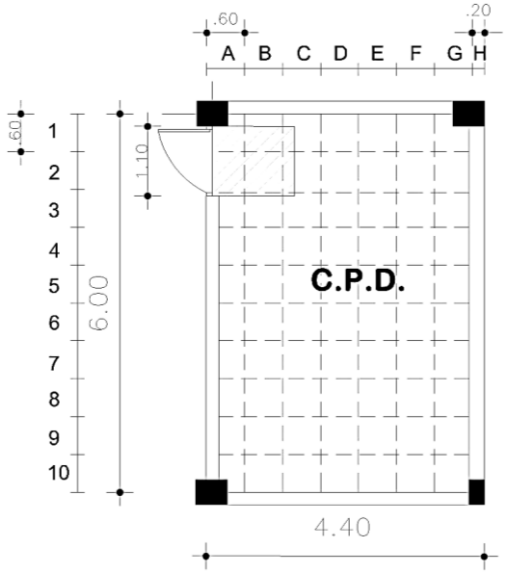

FIGURE V
GRID LOCATION CPD.
Source: Prepared by the author

As a rule describes a grid of identifying and locating ICT equipment will be used. In the x-axis (x), they are located uppercase letters A through H; and the ordinate axis (y) have been located numbers from 1st to 10. The dimensions of the grid are of 0.60 [m], as shown in *Figure V*.

Luminaires located in the data processing room are fluorescent type; in sets of 6 lamps and there are 2 sets today. For the number of lamps used in the CPD, a calculation is performed using equation I, recorded below:

$$Número\ de\ lámparas = \frac{nivel\ de\ iluminación * área\ del\ lugar\ a\ iluminar}{flujo\ luminoso * factor\ de\ utilización * factor\ de\ mantenimiento}$$

FIGURE IV
CALCULATION OF NUMBER OF NUMBER OF BULBS

$$Número\ de\ lámparas = \frac{350 * 26.40}{1900 * 0.4 * 0.8}$$

$$Número\ de\ lámparas = \frac{9240}{608}$$

$$Número\ de\ lámparas = 15.19 \cong 16$$

As a result it has the approximate number of 16 lamps. By having two sets of reference 6 each lamp, a system is increased, with a total of 18 fluorescent lamps, distributed as shown in *Figure V*.

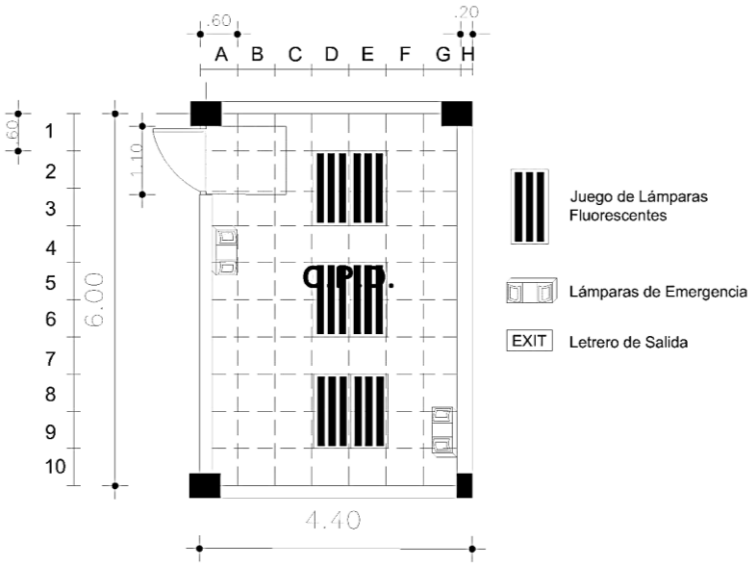

FIGURE VI
LOCATION OF LAMPS CPD.
Source: Prepared by the author

1) Electrical Installation: The CPD has a separate electrical feeder. The transfer board supplies electricity to all the equipment room.

The current facility has the necessary requirements to meet consumer demand for computers that are within the CPD; so it will not focus on the electrical system, but rather in the relocation of energy sources for the operation of communications

equipment such as UPS and battery banks. One transformer K20 locking specifically with loads of servers (mainframe) is recommended.

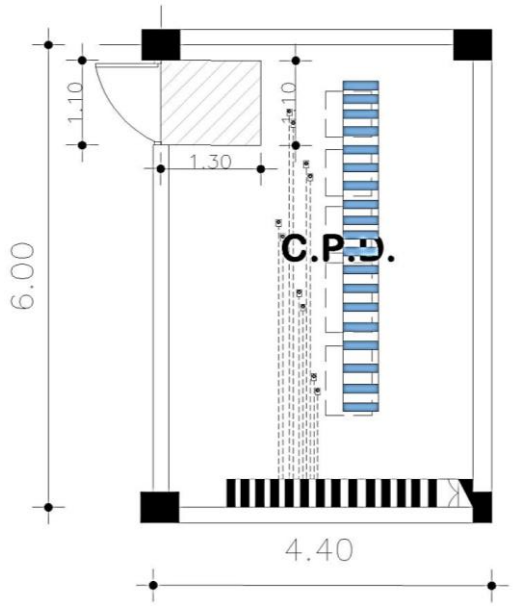

FIGURE VII
LOCATION OF ELECTRICAL CANALIZATIONS OF CPD.
Source: Prepared by the author

All products of electrical parts are metal (internal and external pipes) taking care of the electrical continuity across the path with their respective identification. These steel or aluminum pipes should not be among them a distance greater than 6´´. *In Figure VI* the distribution of electrical canalizations is displayed.

Study of loads is performed to determine the ability of the UPSs must have the CPD. The following table summarizes the estimated total power in the data center, based on the following *table IV:*

TABLE IV
ESTIMATED MAXIMUM POWER CONSUMPTION FOR ELECTRIC CHARGE TOTAL FOR CPD

DESCRIPTION	ACTIVE EQUIPMENT	LOAD [KVA]
COMUNICATION RACK #1	SWITCH 3COM 2928	0,456
	SWITCH 3COM 2928	0,456
	SWITCH CISCO 3850	0,437
	SWTICH 3COM 4500G	0,108
COMUNICATION RACK #2	SWITCH HP JD377A	0,826
	SWITCH 3COM 2928	0,456
	SWITCH 3COM 2924	0,437
	SWITCH 3COM 2452	0,456
COMUNICATION RACK #3	ROUTER CISCO 800	0,031
	ROUTER CISCO 800	0,031
	SWITCH CISCO 1941	0,137
TOTAL CARGA 1 (N1)		**3,8**
SERVER RACK #1	HP PROLIANT BL460c GEN8	0,970
	HP PROLIANT BL460c GEN8	0,970
	HP PROLIANT BL460c GEN8	0,970
	HP PROLIANT DL380 GEN6	0,540
	HP PROLIANT DL380 GEN6	0,540
	HP PROLIANT DL380 GEN7	0,540
	HP PROLIANT DL380 GEN7	0,540
SERVER RACK #2	SERVIDOR IBM	1,100
	SERVIDOR VIOSTOR QNAP	0,100
	FIREWALL SOPHOS SG330	0,012
	GATEWAY ASTARO 320	0,187
TOTAL CARGA 2 (N2)		**6,469**
OTHER LOADS	CCTV SYSTEM	0,031
	CENTRAL ALARM	0,224
GROWTH PROJECTION	GROWTH FACTOR (100%) (N1+N2)*1,0 **(N3)**	**10,269**

Note: the author's own research

CPD for precision air conditioning equipment to control the temperature, relative humidity and air cleanliness is needed. Two teams of the same precision that are distributed as shown in *Figure VII*

to cover a greater area used, maximizing its ability to function with respect to the new dimensions of CPD based on their characteristics. Stulz equipment brand, model 151A MiniSpace CCU is recommended. The temperature in the room will not exceed 22 degrees Celsius and the display of equipment not exceeding 21 degrees Celsius.

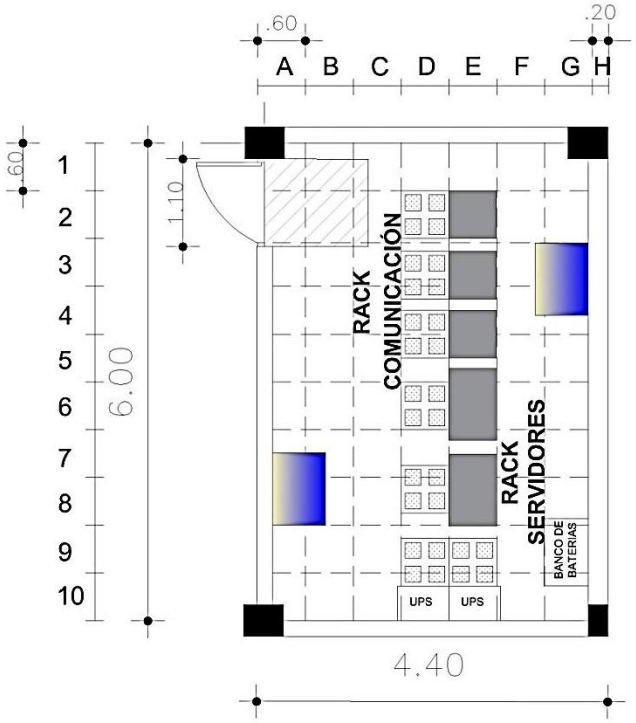

FIGURE VIII
LOCATION OF AIR CONDITIONING IN THE CPD.
Source: Prepared by the author

For security reasons, if any furniture or accessories needed such as landfills; all these elements must be of antistatic material, non-combustible and do not contain PVC, because using them would represent a load of fuel and generates risks.

All personnel have access to the facilities of the CPD, must have knowledge of all safety systems, so that when the time indicated may use them depending on the event you need. It takes detectors photoelectric smoke floor as electrical wiring goes under the false floor *(see figure IX).*

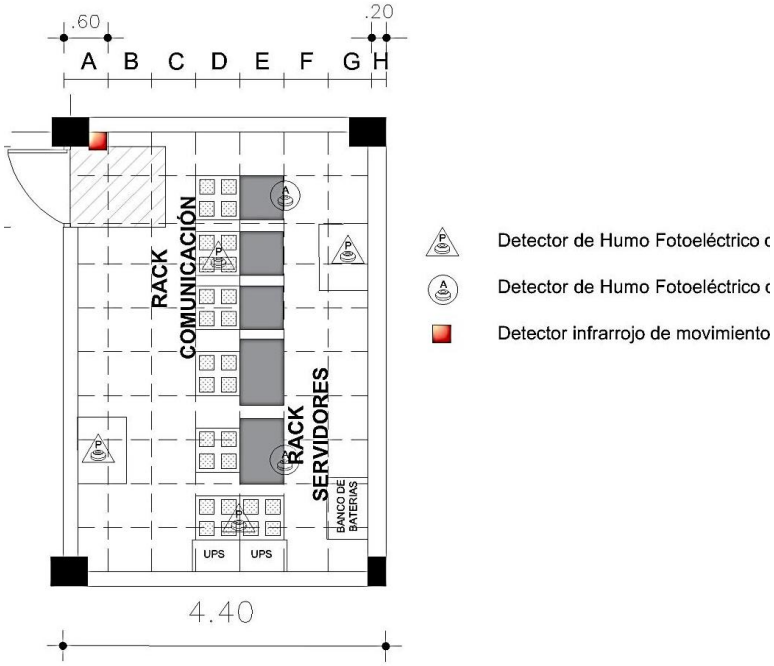

FIGURE IX
LOCATION OF THE SENSORS CPD.
Source: Prepared by the author

The portable fire extinguisher be located in near the personal access door *(see Figure X)*. To locate the fire extinguisher in this position has taken the outline of the standard that indicates that you should not move more than 12 [m] to take it and use it.

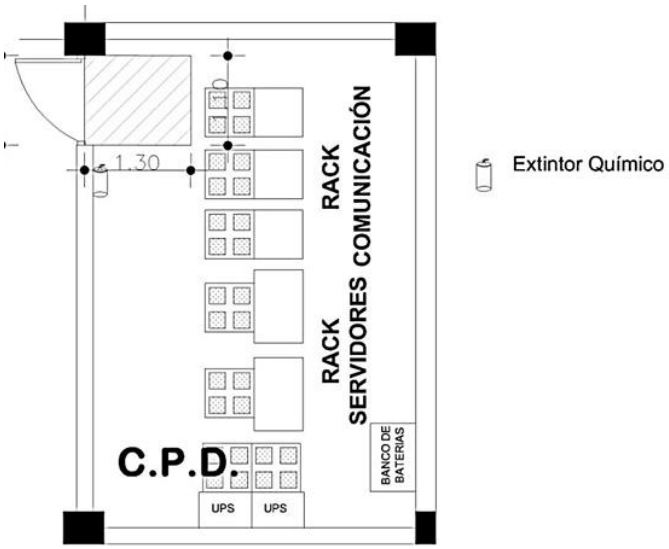

FIGURE X
PORTABLE EXTINGUISHER LOCATION IN THE CPD.
Source: Prepared by the author

All cameras located at strategic locations to monitor all the possible area *(see figure XI);* in order to safeguard the information and equipment that is within the CPD. Video surveillance system

must be analog. The cameras record should allow day / night and on digital video with a minimum storage time video of 10 days.

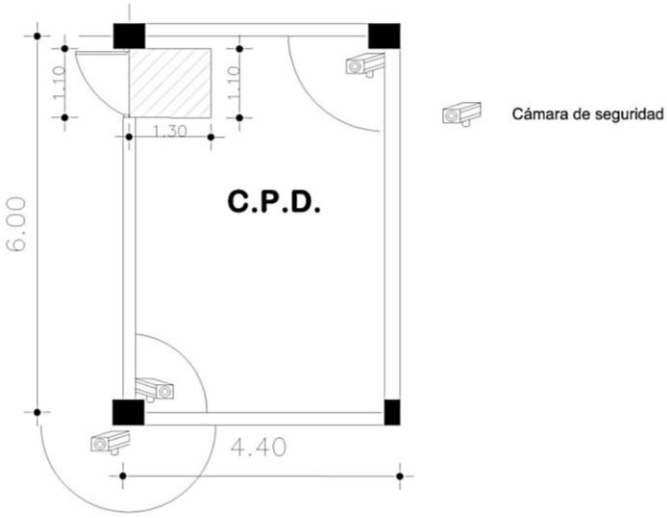

FIGURE XI
LOCATION OF SAFETY CAMERAS CPD.
Source: Prepared by the author

IV. REFERENCIAL BUDGET

The project design demand a reference budget for implementation.

TABLE V
TOTAL BUDGET AND STRUCTURED WIRING SYSTEM DATA CENTER

TOTAL	
DETALLE	**SUBTOTAL**
ROOM OF DATA PROCESSING	
ARCHITECTURAL	9805,60
ELECTRONIC	25334,89
ELECTRIC	56568,56
MECHÁNIC	49181,85
CIVIL WORK	5.435,52
CONTROL ACCESS	1.490,00
SUBTOTAL C.P.D.	*147816,42*
STRUCTURED WIRING SYSTEM	
STRUCTURED CABLING	71.562,26
SUBTOTAL S.C.E.	*71.562,26*
TOTAL PROJECT Exc	**219378,68**

Note: the author's own research

Design quotes Structured Cabling System and Data Processing Room is present below *Table 5* presents quotes.

V. CONCLUSIONS

The lifting of the current status information of the data network GADMO both performed: nodes, work areas, vertical wiring, horizontal wiring and active equipment; in addition to the equipment room, location, access control, civil engineering, electrical wiring, air conditioning and so broad and clear picture for the start realization of the project design it was obtained; to know the shortcomings and emphasize the needs of the municipality.

The certification of each data network points where the design was raised with the result that only 21% passed the certification was performed; addition to each of the nodes where no node passed the certification validating parameters such as mapping wiring, cable length, insertion loss, among others allowing to set the current state of the network using equipment Fluke Networks DTX-1800 allowed the documentation for each certificate permalink.

A design of relocation and expansion of network points, both data and voice is made, considering not only the standard structured cabling ANSI / TIA / EIA-568, but also the needs of users of the facilities as they He conducted a study of growth of personnel in the municipality; thus proposing a design that supports structured cabling services: voice, video and data scalability of 5 years.

The design of structured cabling was performed using UTP Category 6A / Class EA, justifying that the category of cable meets the requirement of bandwidth for the transmission of IP telephony is done in real and equally time scalability is guaranteed wiring 15 years.

The room data processing was designed based on the International Standard ICREA-STD-131-2013, considering parameters: field, electrical installations, air conditioning, security and communications to reach a level I data center; the whole design was done with the approval of trained personnel for each area including engineers, technologists and architect staff.

We documented all the design: tables and images to make use of the project when it deems appropriate from GADMO administration; both designs and Data Center Structured Cabling are registered in architectural drawings and single line diagrams that will guide future installation.

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BIOGRAPHY

Ona B. S. Abigail was born in Antonio Ante - Ecuador on 29 April 1990. Their primary studies realized in the Fiscal School for Girls "Sarance"; in 2007 he obtained his school specialization Technical Physics and Mathematics in Instituto Técnico Superior "Republic of Ecuador; in the same year he became a student undergraduate at the Universidad Técnica del Norte in the Career of Electrical Engineering and Communication Networks. He completed his pre-professional practices in the Autonomous Decentralized Municipal Government of Otavalo performed tasks Installing network points, technical support, equipment configuration L2 and L3, gathering information, monitoring and IP inventory.

He currently works as Technical Project Monitoring Network Operation Center of Telefonica in the city of Quito.