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Electronic civil surveillance: review oriented to communications for monitoring and a case

Vigilancia electrónica: revisión orientada a comunicaciones para centrales de monitoreo y un caso

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ABSTRACT:

This article, in the context of documentary research carried out and interpreted for that was taken as baseline in investigations on electronic security and their themes for the ORCA group, it´s describe the state of the art of electronic surveillance focused in communications for monitoring stations. It's set up chronologically in the last decade, in Latin America, and Colombia particularly. The subject has been categorized and subcategorized in such a way that keys are established sources extraction: university digital repositories, online academic magazines and corporate web page. As a product produced by the review, a particular communication model is presented for a case of a monitoring center and a equipment for tracking people.

RESUMEN

El presente artículo, en el contexto de una investigación documental realizada e interpretada para que fuera tomada como línea base en investigaciones sobre seguridad electrónica y sus temáticas para el grupo ORCA, describe el estado de arte de la vigilancia electrónica enfocada en comunicaciones para centrales de monitoreo. Se establece cronológicamente en la última década, en Latinoamérica, y particularmente en Colombia. La temática se categoriza y subcategoriza de manera que se establecen claves para la extracción de las fuentes: repositorios digitales universitarios, revistas académicas en línea, y páginas web corporativas. Como producto arrojado por la revisión se presenta un modelo particular de comunicación para un caso de una central de monitoreo y un equipo de rastreo a personas.

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1. Introduction

Insecurity in Latin America is the highest in the world: it accumulates the 37% of homicides worldwide. One of the factors behind this violence is organized crime, which since 2000 year has caused the same number of deaths as armed conflicts, [1]. In Colombia, 44% of people feel insecure: only in 2018, 15.6% of the Colombian population was victim f a crime, for example, [2].
Therefore, among many other technological phenomena, electronic security systems have advanced and applied in a greater proportion in countries and cities from Latin America. Thus, technological tools have complemented the work of private surveillance operators. In this sense, we can find different subsystems that integrate electronic security: perimeter protection (physical barriers); access control; alarm monitoring; video surveillance systems; detection and extinction of fires and electronic surveillance, among others, [3].

In the case of perimeter protection systems, those that allow demarcation of legal limits, prevent unauthorized persons entering a secured area, delay access to increase the possibility of detection and response, there are other elements: natural site, structural precast, electric fences, among other adaptations. Regarding access control systems, they are applied to allow or deny the entry of people, vehicles or packages to certain places of any installation or property; among these systems are: biometrics with short or long range card (UHF[3]); facial identification with or without login passwords. Alarm monitoring systems aim to report any type of intrusion detected by an alarm system; this action may notify the police, monitoring center, supervisor or a technician. In general, it is composed of motion detection sensors, photoelectric barrier sensors, alarm center, GPRS,[4] among others. Meanwhile, video surveillance systems are mainly used for live surveillance; reconstruction of events after an event; and deterrence, among other activities. It is composed of conventional cameras, IP[5] cameras, PTZ,[6] DVR,[7] hard drives. As for fire detection and extension systems, they have the main function of alerting and in certain cases preventing fires. They are mainly compounding of smoke sensors, temperature sensors, firefighting plants, clean agents, among other physical scenarios.

In particular, electronic surveillance encompasses all satellite location systems (GPS[8]) that allow the control, protection, and constant monitoring of any good or service in real time, [3]. In this electronic security system, and particularly with regard to communication from monitoring centers combined with human tracking equipment, the literature is dispersed and academically are not systematically ordered.
In the last sense, this article focuses on establishing a baseline for electronic security research for the ORCA group; structured as follows: initially the review methodology is presented using the index categorization method; the information collected is subsequently developed and interpreted; then the methodology is established to choose a case focused on communication between an equipment and the monitoring center in the Colombian context; finally, the conclusions and recommendations of the review are given.

2. Methodology

Research and applications in electronic surveillance have been carried out in the last decade with the purpose of establish efficient communications in this context. However, the topic of monitoring stations and associated GPS tracking devices has not been sufficiently explored. Consequently, an exploratory research is established based on a bibliographic search in university digital repositories, online academic journals, and corporate web pages, the electronic surveillance category has been chosen; and subcategories: real-time monitoring, cellular network infrastructure, network operators, reception of signals in a central, GPS tracking device; these threw descriptors to find sufficient records to establish a state of the art and establish a particular case in the Colombian context.

For the present document, the index method is used to build the revision [10], validated by experts from ORCA. The categorization and subcategorization of the topic in Electronic Security and Electronic Surveillance are shown in Figures 1 and 2, respectively.

3 Ultra-High Frequency, labels based on dipole structures, [4].
4General Packet Radio Service, which is a network of packets superimposed on top of GSM, [5].
5Internet protocol, cameras that allow you to monitor video and record it from anywhere on the network, [6].
6Pan, Tit and Zoom, cameras that allow pan movement, tilts and enlargements, [7].
7Digital Video Recorder, [8].
8GPS: Global Positioning system, [9].

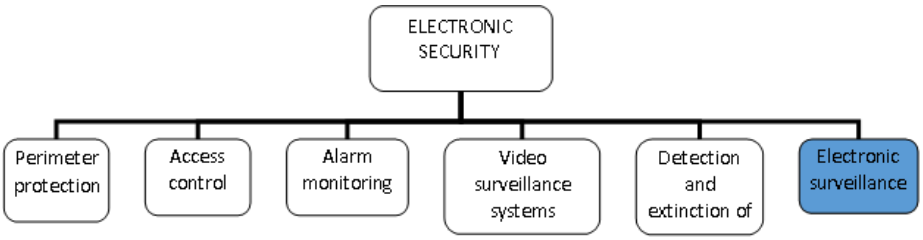

Figure 1. Communications-oriented review for monitoring centers, categorization of electronic security. Source: own.

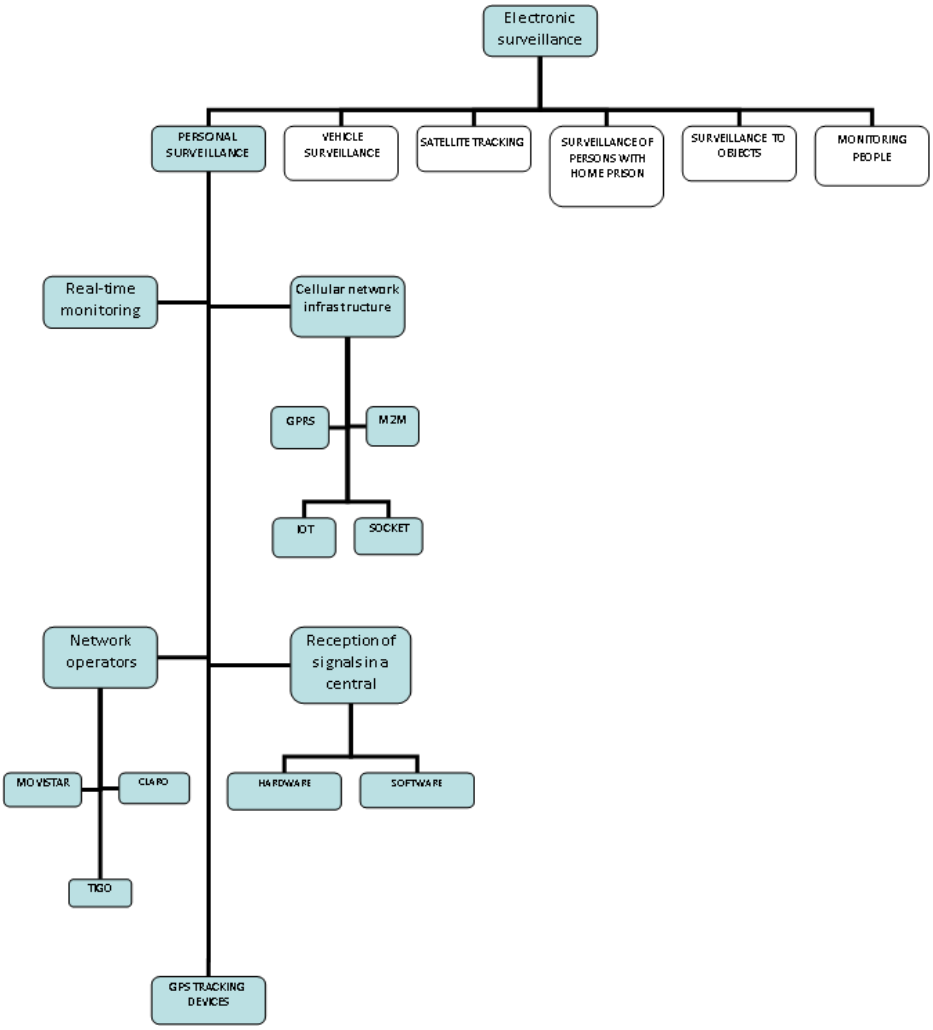

Figure 2. Communications-oriented review for monitoring centers. Subcategorization of Electronic Surveillance. Source: own.

3. Development.

The term electronic surveillance is a branch of that can be considered as electronic security. According to José Miguel Roca, electronic security is the application of information and communication technologies (ICT) to physical security actions, [3]. The implementation of electronic security systems has offered at communities and the public force support in citizen security, contributing to the reduction of criminal risks and improvement of living standards, [11].

Meanwhile, electronic surveillance has its antecedents in applications of people with house arrest, and has become critical due to prison overcrowding and stigmatization, making it necessary to adopt innovative technology-based solutions, [12].

In accordance with the aforementioned problems, the need arises to carry out the implementation of

electronic surveillance as a control mechanism that aims to monitor the traffic, both of defendants and convicts, within a range of action and displacement, taking as a point of reference the domicile or place indicated as such by the person who is the object of said control, [13].

For all these antecedents, in different Latin American countries electronic surveillance is regulated: in Peru through Law No. 29499 [14]; in Bolivia through the regulated use of the electronic bracelet, [15]. In Colombia, meanwhile, electronic surveillance has been implemented with mechanisms such as: passive RF[9] tracking, active GPS tracking and voice recognition, [16].

3.1. Real-time monitoring

Currently, there are multiple monitoring applications for different problems: implementation of electronic surveillance as a method of prison sentences in some Latin American countries, [17]; web applications for the geolocation of pets by GPS equipment, [18]; vehicle monitoring, [19]; personnel monitoring, [20]; protection of students and teachers in educational institutions, [21]; tracking of elderly or mentally handicapped people, [22]; geolocation systems and monitoring of high-risk medical patients, [23]; location systems to determine alternate routes using GPS and GPRS technologies, [24]; geographic information platform for disaster prevention and response, [25]; web platforms for GPS tracker devices, [26]; technological platforms applied to climate monitoring, [27].

Of the reviewed monitoring applications, all share the use of GPRS and GPS systems in order to effectively obtain locations; Additionally, most are custom developed.

3.2. Cellular network infrastructure

In order to send the data from the watch or GPS device, it is necessary to have an available communication channel that provides the means for sending the signal. Next, the operation of a cellular network for this type of applications will be described.

3.2.1. GPRS

The GSM network provided communication services through circuit-switched transfer, which implied that once the physical connection between two devices was established, all resources were dedicated until the request to disconnect the devices was sent. This type of connection worked for voice communication, but for data transmission or Internet connection it became obsolete.

Therefore, it was necessary to develop a technology that would allow greater advantages when it comes to communicating and sending data frames, [29]. This gave rise to GPRS technology, which has a packet switched data transfer in link by link mode, that is: information packets are sent through different service nodes. This allows a higher transmission speed, connection to the Internet cloud through TCP/IP[10], X.25[11] and CLNP[12] protocols, [30].

3.2.2. M2M

For its acronym -machine to machine- M2M is the communication and exchange of information between two machines remotely. This communication is achieved through the communication of a server which manages the necessary information on the machine; Communication between the machine and the server can be carried out by different means, among which are: LAN[13] connection, WIFI[14] router, GSM[15] or GPRS, [31]. Communication between the two machines is generally done through a SIM. Figure 3 shows a general diagram of the operation of M2M communication through the cellular network.

Figure 3. Communication operation M2M, [32].

3.2.3. IoT

For its acronym -Internet of Things-, is a term used to refer to a connection between devices, systems or services. This in order to obtain different parameters from various equipment automatically, which arrive at a data processing center where decisions are made depending on the data obtained, [38]. Figure 4 shows a general diagram of how the Internet of Things works.

9 Radio frequency, [28].
10 It is a protocol for communication in networks that allows a dispositive to communicate within a network, [33]
11 It is an interface between data terminal equipment and data circuit termination equipment, [34].
12 Protocol used to transport data and error indication at the network level, [35].
13 Local Area Network, [36].
14 Wireless connection mechanism that is compatible between different devices and networks, [37].

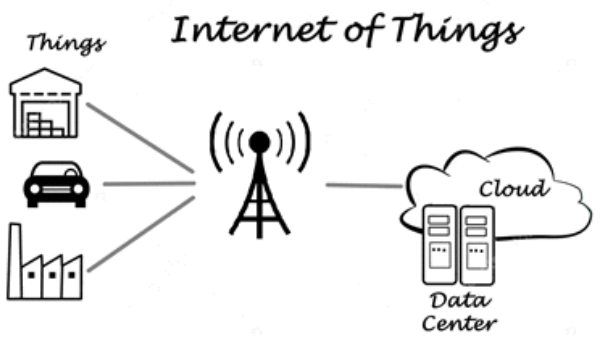

Figure 4. Operation scheme IoT, [38].

3.2.4. SOCKET

In a client-server communication, the server is always waiting for information supplied by the client. Therefore, the server has a socket with a specific port; the server is always waiting for any information that enters through this port and thus store or process it, [40].

3.3. Network operators

Both the Internet of Things and the M2M connection allow communication between computers or devices to a data center or Datacenter. Next, the different plans that currently are offered - generically and in Colombian pesos - are offered by network operators of these technologies.

3.3.1. Movistar

Movistar offers data packages dedicated to only sending information or vertical data; This service is sold by the amount of KB used, as shown in Table 1.

OPEN VERTICAL DATA PLANS			
Service description	Units included	Value with IVA	Additional Kb value with IVA[1]
Vertical data 3MB AB	3MB	$3.900	$0,24
Vertical data 5MB AB	5MB	$4.900	$0,24
Vertical data 10MB AB	10MB	$6.100	$0,24
Vertical data 15MB AB	15MB	$7.100	$0,24
Vertical data 25MB AB	25MB	$8.100	$0,20
Vertical data 50MB AB	50MB	$9.200	$0,20
Vertical data 100MB AB	100MB	$9.800	$0,24
Vertical data 400MB AB	400MB	$14.700	$0,24
Vertical data 1GB AB	1GB	$22.700	$0,24
Vertical data 2GB AB	2GB	$47.400	$0,20
Vertical data 4GB AB	4GB	$63.100	$0,20
Vertical data 15GB AB	15GB	$514.700	$0,20
Vertical data 30GB AB	30GB	$1.013.300	$0,20

Table I. Movistar vertical data, [41].

In order to ensure that the device is always connected to the network, Movistar offers a multisim solution, which has a cost of $ 107 thousand with a 4GB browsing capacity.
All of the above packages are focused on providing a solution for sending information from a device to a Datacenter information reception and processing equipment, [42], [43]. However, Movistar offers applications to manage geolocation and communication through a cellular device, which may include route histories, [44], [45].

3.3.2. Claro

The most viable option lies in a vertical data package which is summarized in Table 2. There are no discounts on these tables regardless of how many lines are purchased in the plan.

Amount of data in MB	Cost IVA included	Additional KB cost IVA included
1	$3.616	$0,13
3	$4.356	$0,13
5	$5.446	$0,13
10	$6.656	$0,13
15	$7.219	$0,13
50	$8.234	$0,13
100	$10.603	$0,13
500	$16.809	$0,13

Table 2. Clear vertical data costs. Source: own.

Claro does not offer any kind of application for adequate monitoring and geo-location from a monitoring center [46], [47], [48], [49]; therefore, all the infrastructure and communication must be designed.

3.3.3. Tigo.

3.3.3.1. M2M Tigo

It has a regional infrastructure dedicated to M2M that supports local or regional communication. It has the possibility to manage connectivity by choosing the functions and parameters that you want to manage through the platform, [50].
Among some of the benefits that Tigo offers are: discounts for line volumes and loyalty, free trials, security through dedicated APNs, public and private addressing, [51].

3.3.3.2. Tigo mobile location

The Tigo mobile location service is aimed at clients in the corporate segment, which allows the approximate location of registered mobiles to be consulted on the Internet, with an error range between 200 and 300 meters, on a digital map in the urban areas of the main cities of the country under study.
This service consists of a Web page, through which it is accessed with a username and password, once authenticated you can select the number of the cellular device whose location you want to know. The result of the location is given by the cell closest to the user's location, as well as a digital map illustrating the location. It allows to have a history of the locations of the number that you want to consult.
Table 3 shows the cost of the location plan offered by Tigo, including the aforementioned platform.

Number of lines	Basic charge per line including IVA
1 a 3	$12.310
4 a 10	$9.746
11 a 20	$8.207
21 onwards	$5.642

Table 3. TIGO localization package costs. Source: own.

3.4. Reception of signals in a central

In order to establish a stable communication between the monitoring equipment and the Datacenter or monitoring center, it is necessary to know the specifications of the different parameters of the equipment for sending information, this in order to make the appropriate chaining of all the information that equipment is needed. Once this information is available, it is also necessary to configure the IP and the port to which it will be pointed and where the information will arrive in the monitoring device.
In the Datacenter or monitoring center, the data frame received from the device must be resolved, in order to process or store it. For this it will be necessary to configure a Socket in the Datacenter, in order to arrange it for the reception of all the equipment that is required to be monitored.
In alarm monitoring systems the communication of the different events is carried out with GPRS equipment to which a SIM with vertical data is placed and thus, through the Internet, send the different reports to the central. In the central there are two options for solving problems: one is to install a receiving equipment which will receive all the reports from the different subscribers, or the other option is for the monitoring software to receive these reports directly.

3.4.1. Software

Figure 5 shows the configuration that is made in the GPRS of an alarm system; in this you must configure the APN provided by the communications company with their respective users and passwords, the receiver's IP, the receiver's port, the subscriber's number, telephone and life pulse; these last two items are provided by the central and are used in case the GSM network has failures, [52].

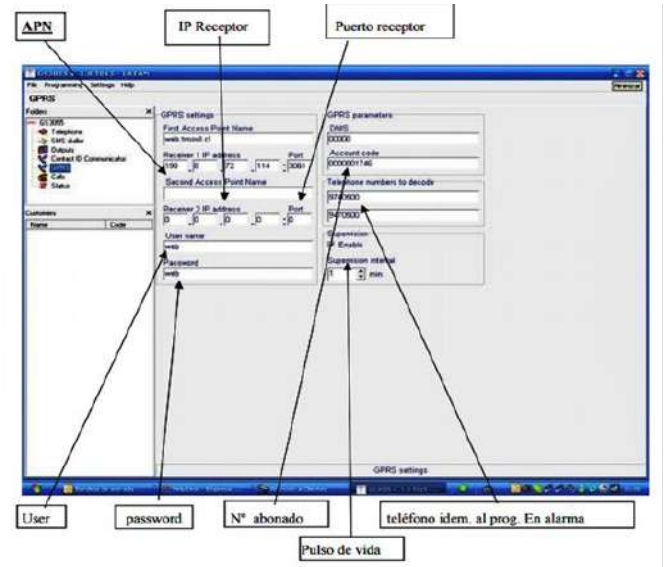

Figure 5. GPRS configuration parameters DSC alarms, [52].

3.4.2. Hardware

As mentioned above, there are two options for receiving GPRS signals from monitoring equipment. One of the options outlined above is through signal reception through software and direct connection to the Datacenter.
Another option to receive the signals coming from the equipment through the GPRS network, is to implement a receiver and for it to send the received signals to the Datacenter.
Some GPRS signal receivers for monitoring alarm signals are listed below.

3.4.2.1. Central reception of alarms with a card of three telephone lines

The MX8000, Figure 6, allows the connection of up to

36 telephone lines in a single receiver, providing the option of having multiple receivers in a consolidated unit. Supports a maximum of 12 line cards, front keypad for manual operation and programming, LEDs that indicate system operation and programming, RACK mount design, telephone line cards are individually programmable for formats, priorities, and ring parameters. The telephone line cards support direct connection to the monitoring telephone line, [53].

Figure 6. GPRS MX80003 receiver, [53].

3.4.2.2. Central receiver type PCI or PCI-E for installation in two-line computer (Exprecium-d)

It is ideal to start with a monitoring center at a very low cost since the cabinet and the power are provided by the PC and make it a professional control panel. Includes 2 lines per card and up to 12 cards can be added per PC; it allows to operate a central alarm on a large scale or simply to supervise inputs and outputs, [54].

Figure 7. PCI type receiver, [54].

3.4.2.3. EXTRIUMDB alarm receiver

The main characteristics of this receiver, figure 8, are as follows: memory for 12,000,000 events, backup via SD card; internal database for 4,000 accounts with the capacity to directly manage events, can be accessed from a WEB browser from a PC or mobile device, [55].

Figure 8. EXTRIUMDB receiver, [55].

The main characteristics of this receiver, figure 9, are the following: memory capacity of 8,000,000 events; ARM processor with embedded Linux; 3 data output ports, IP, serial and USB; Embedded WEB server for configuration through browser, [56].

Figure 9. Decrypta receiver 6, [56].

3.5. GPS TRACKING DEVICES

3.5.1. Mini waterproof GPS PM01

This equipment, figure 10, OEM/ODM brand - distributed by Shenzhen Yushengchang Technology Co. Ltd - is a small waterproof GPS tracker that allows location by GPS, AGPS, LBS and WIFI technologies. For location through the cellular network, a Micro SIM must be inserted into the equipment, which can operate at the following frequencies: 850/900/1800/1900 MHz. The location accuracy provided by GPS, AGPS and WiFi is 5 to 15 meters, while the accuracy provided by LBS is 10 to 100 meters. It has an emergency SOS button, with which you can automatically send help or emergency messages; it has a low power consumption system and low battery alerts, which lasts approximately 100 hours in saving mode. The monitoring can be done through SMS, APP or Website; in case of choosing APP, it must be downloaded for Android and IOS Setracker or Setracker2. Geo-fences can be saved in these applications and the device will issue alerts about the entrance or exit to them. It has the option of a phone call, in which you can listen to that is happening around the device, [57].

Figure 10. Mini Waterproof GPS Reference PM01, [57].

This equipment is used for tracking applications to children, the elderly, remote monitor, luggage tracking, pet location. Depending on the application, it can be hidden in pockets, collar or handle type. It has a cost of $ 22 US.

3.5.2. V28 OEM GPS Tracker

This OEM brand equipment, figure 11, is a small GPS tracker with built-in emergency button and easy call button. It allows to know the location history of up to 90 days and the routes followed; it also allows to create geo-fences for the corresponding alert -if you arrive or leave these places-, two-way communication for phone calls, option to mute incoming calls to use the equipment for audio monitoring. It has low battery alerts and has long battery life in idle state with a duration of 7 to 10 days. The location is carried out using GPS / AGPS technology with an accuracy of 10 to 15 meters; LBS with an accuracy of 100 to 1000 meters; and WIFI with an accuracy of 15 to 100 meters, [58].

Figure 11. V28 GPS Tracker, [58].

It works with a SIM CARD in the following frequency bands: 850/900/1800/1800/1900 MHz. It has a cost of $ 28 US.

3.5.3. Mini GPS tracker Q1

This Fifotrack brand equipment, figure 12, is a mini GPS used to track children, the elderly, assets and vehicles. It works through the GSM network in the 4 available bands; it has a high battery life depending on the intervals of obtaining the positions, with the shortest every 30 seconds and the longest 60 minutes with a duration of 11 hours and 96 hours, respectively. The location can be done using GPS / GGPS / GSM technologies with an error in the location of 10 meters, allowing real-time tracking of the person or object that is loading it. It allows creating geofences for their corresponding alerts, it works as a voice monitor, fall alarm, SOS button, [59]. This equipment has a cost of $ 40 US for orders over 50 units and the smallest order is 20 units for $ 52 US.

Figure 12. Q1 GPS Tracker, [59]

3.5.4. Mini portable GPS PT90

This Topshine brand equipment, figure 13, allows real-time monitoring of children, the elderly and luggage. It allows alerting cell phones to 3 previously connected numbers, with which two-way conversations can be established. Among its main functions are: fall alarm, anti-loss alarm, real-time monitoring by web platform, panic button, battery life in normal 12-hour work or in 24-hour saving mode, pre-configured geofences alarm, obtaining location by SMS. It has its own platform and mobile application. It is necessary to install a SIM card to make the connection via SMS / GPRS (TCP / UDP). It has a specific cost of the number of equipment requested: 1 to 9 for $ 49 US, 10 to 49 for $ 47 US, 50 to 199 for $ 46 US, 200 to 999 for $ 43 US and more than 1000 for $ 40 US, [60].

Figure 13. PT90 GPS Tracker, [60].

3.5.5. Super mini GPS RF-V13

This E-Track brand equipment, figure 14, allows real-time location; it has its own tracking platform and all the configurations can be done through the tracking application. Among its main features are: adjustable vibration sensor, integrated window and door opening and closing sensor, highly sensitive sound sensors, voice monitoring, low battery alert, SIM change alarm. It allows the location by means of GSM / GPS / LBS technologies with a location error of 100 to 900 meters.

It has a battery life of 4-5 days in economy mode. It costs $ 27 US for orders of 1 to 9 teams and $ 26 US for more than 10 teams, [61].

Figure 14. Super mini GPS RF-V13, [61].

3.5.6. RF-V6 Mini Tracker

This Reachfar brand equipment, figure 15, allows real-time monitoring of any person or property to which this device is installed. Allows location by LBS / AGPS technologies with an accuracy of 100 to 1000 meters and WiFi with an accuracy of 15 to 100 meters; it has a 2G GSM connection in 4 bands; it has a battery life in saving mode of 300 hours. It can track it through an application for Android or IoS or by sending the location via SMS; the application allows viewing a movement history of up to 90 days. It allows creating geofences for their corresponding alerts, [62]. This equipment has a cost of $ 53,800 COP.

Figure 15. RF-V6 Mini GPS Tracker, [62].

3.5.7. Keychain GPS finder Marvel-tracker01

This equipment is an OEM brand mini keychain type tracker, figure 16. It allows obtaining the location of the person who is using it through GPS / LBS technology, with a position error between 5 to 15 meters; connections can be made via GSM / GPRS. The configuration and display of the locations can be done through an application, which allows viewing the history of the last 90 days. It has a two-way communication channel, a low battery alarm, and costs $ 20US for the purchase of equipment or $ 35US for the purchase of a unit, [63].

Figure 16. Keychain GPS finder Marvel-tracker01, [63].

3.5.8. KIM-GPS GPS Tracker

This JZ brand equipment, figure 17, allows the location and tracking of children, young people, the elderly, patients and / or travelers. Among the main features are: positioning by AGPS / GPS technology, two-way voice communications, fall detection. It has a cost of $ 60US for an amount of 10-99, $ 55 for an amount of 100-499, $ 50 US for an amount of 500-999 and $ 40US for more than 1000 teams, [64].

Figure 17. KIM-GPS GPS Tracker, [64].

4. Materials and methods: communication case between monitoring equipment and monitoring center.

Thanks to the categorization obtained by the different sources and based on some developments in electronic surveillance in similar cases, it was possible to develop a specific case of communication between monitoring equipment and a monitoring center, Figure 18.

Therefore, it is necessary that the monitoring equipment (watch or bracelet) include a GPRS communication module, which can be configured with minimum data such as: destination IP or IP of the monitoring center with its corresponding listening port, PBX telephone number, events to send or parameters of sensors and GPS, APN data, username and password supplied by the network operator. All these previous data must be programmed in the GPRS module in order to establish adequate communication with the monitoring center.

Once the GPRS module is guaranteed, it must have a SIM CARD with its corresponding vertical data package. With it, events and signals will be sent over the Internet through the operator's network.

Therefore, if the signal is sent correctly from the monitoring equipment, it is necessary to have a reception system for such signals. For this reception there are two options:

- The first is to receive these signals directly in the monitoring software, where the public IP and the listening port are configured; once these two main components are guaranteed, the software must have the capacity to store the signals received in a database, which can be consulted at any time. In this option, the

software is responsible for carrying out the entire decryption process of the information received, in order to be able to define the location of the equipment, sensor parameters, panic signals, among others.

- The second option is to install a central station, which will decipher the information received from each user and store it in its internal memory. This receiver must communicate with the monitoring software and send the requested signals to it in order to know in real time parameters such as location, sensor signals, panics, among others. This receiver will directly save the events and information received, depending on the capacity of the same, and this information may be consulted at any time through the monitoring software.

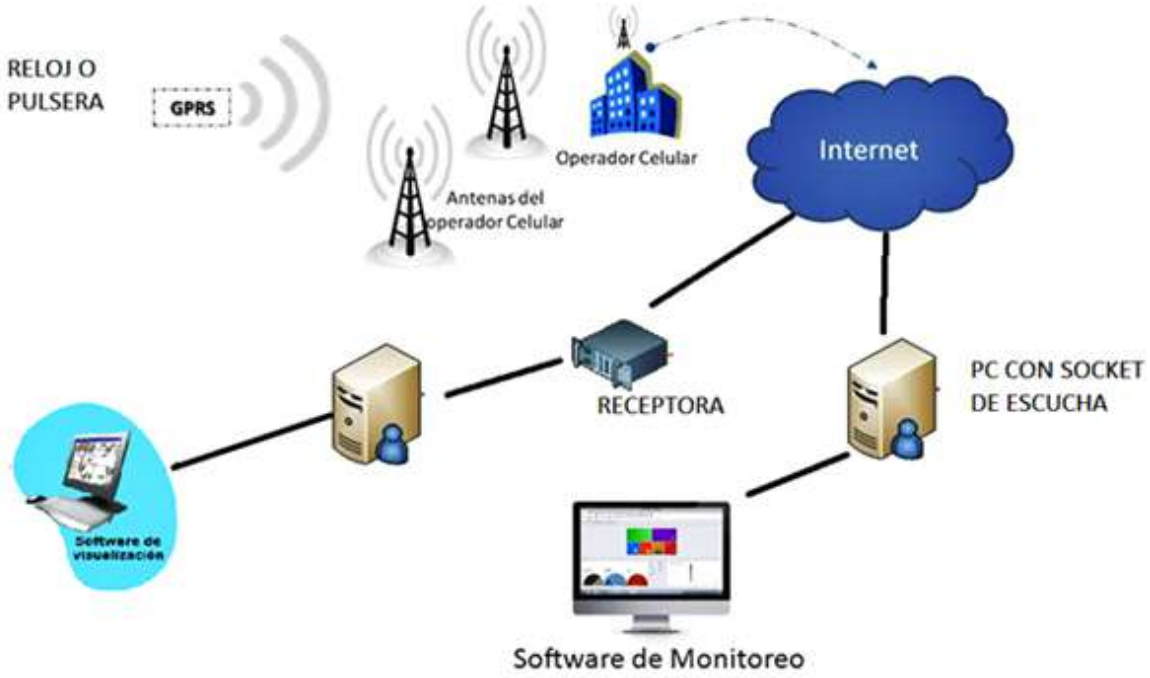

Figure 18. Diagram of equipment communication and central monitoring operation. Source: own.

5. Results and discussion

The different electronic surveillance applications found focus on developments to monitor people deprived of liberty with the option of house arrest (3.84%); monitoring of fleets and company personnel that allow adequate control of assigned routes (2.56%); satellite tracking of pets in case of loss of them (1.28%).
Therefore, it is evident that there are no applications developed for the purpose of real-time monitoring of people from a monitoring center; this in order to be able to inform family members about entering high-risk areas or denied sites to visit, either due to their criminal risk or age restrictions.

Therefore, the case applied to the Colombian environment, manages to identify what is necessary to acquire a SIM with vertical data that allows the issuance of the location of the GPS equipment to the monitoring center; In this monitoring center, the configuration of the signal receiver is carried out in order to receive and interpret the signals sent by the GPS equipment, and their interpretation. These signals can be received by means of the signal receivers described above or by means of monitoring software and its corresponding suitable socket configuration.
Finally, this research review allows recognizing: equipment, systems, and generalities as a baseline for research and implementations aimed at monitoring, from a central, to people. The foregoing is sensitive in the case of research and development projects in government-level tenders, particularly in Colombia. Consequently, based on the state of knowledge in communication equipment and protocols, pilot projects can be established to facilitate operating conditions in situ and under real use parameters in private or public tenders.

6. Conclusions

Table 6 shows a comparison of prices and discounts among the most notable services of the three operators reviewed, in the Colombian case.

MOVISTAR			CLARO			TIGO		
MB	COST	DISCOUNTS	MB	COST	DISCOUNTS	MB	COST	DISCOUNTS
1	$3.900	1 a 19 lines 0%	1	$3.616	They do not offer discounts.		$12.310	1 a 3
3	NA	20 a 49 lines 10%	3	$4.356			$9.746	4 a 10
5	$4.900	50 a 99 lines 15%	5	$5.446			$8.207	11 a 20
10	$6.100	100 a 349 lines 20%	10	$6.656			$5.642	21 onwards
15	$7.100	Más de 350 lines 25%	15	$7.219				
25	$8.100							
50	$9.200		50	$8.234				
100	$9.800		100	$10.603				
400	$14.700		500	$16.809				
1000	$22.700							
2000	$47.400							

Table 6. Comparative main operators costs. Source: own ▪

Claro does not offer a platform for location and line monitoring, Tigo offers the location platform and the cost of it is included in the costs detailed in Table 4, Movistar offers a platform for real-time viewing without location history for a cost monthly of $ 41,900 plus IVA or the field personnel management application for a cost of $ 32,400 plus IVA.

Therefore, of the network operators, the best option would be offered by Movistar in terms of cost-benefit ratio, discounts and megabytes of surfing for communication via GPRS.

On the other hand, the different research articles and thesis documents found are aimed at the development of electronic surveillance of people with house arrest (3.84%), pet monitoring (1.28%), vehicle and fleet monitoring systems (2.56%), monitoring of high-risk patients (0.64%). But no developments were found leading to a monitoring center for people.

The sources found, for the most part, focus on Peruvian developments; concluding that this Latin American country is one step ahead in terms of regional research. Therefore, it is necessary to intensify research projects in this field in Colombia in order to solve problems of overcrowding and security through appropriate monitoring applications -either to people with house arrest or to ordinary people.

The found sources of investigations in Colombia propose development options in different subcategories of Electronic Security; However, there are no investigations that account for the different systems proposed and thus systematically document the area technologically. It is highlighted that the percentage of sources obtained from digital repositories of the total reaches 9%.

In perspective, to implement and test the proposed solution case in this research, they establish some technological terms of reference: monitor people with small GPS devices, which can be easily hidden or loaded; these devices mostly have SOS emergency buttons; tracking equipment must be constantly connected to the internet, for which it is necessary to have a SIM CARD that allows connection to the network through vertical data offered by network operators; once obtained, the control panel receives the signal from the devices for which the described signal receivers are adapted or by means of software and its corresponding configuration. And other sectors to implement electronic civil surveillance, [65-73].

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