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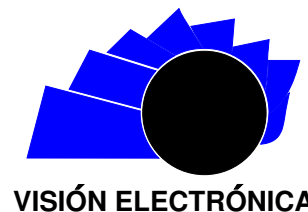
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A CURRENT VISION

State of art on telematic infrastructure for telework

Estado de arte sobre infraestructura telemática para el teletrabajo

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ABSTRACT

The Ministry of Information Technologies and Communications (MinTic) of the Republic of Colombia has regulated and adopted teleworking (TT) as a valid work modality as an indicator of the country's occupation. For the above, and seeking to be a baseline for research in the area, this article reviews the technological solutions, tools and infrastructure Telematics implemented -from the 70s to the present in organizations that have ventured into TT. The technological needs of the teleworker are stated, particularly those associated with the organization; and, finally, a proposal of Information and Communication Technologies (ICT) is presented that can be used by organizations according to the type of TT that they assume.

RESUMEN

El Ministerio de Tecnologías de la Información y las Comunicaciones (MinTic) de la República de Colombia, ha regulado y adoptado el *teletrabajo (TT)* como una modalidad laboral válida como indicador de ocupación del país. Por lo anterior, y buscando ser una línea de base para investigaciones en el área, el presente artículo realiza una revisión sobre las soluciones tecnológicas, herramientas e infraestructura Telemáticas implementadas -desde los años 70 hasta la actualidad- en organizaciones que han incursionado en *TT*. Se enuncian las necesidades tecnológicas del teletrabajador, particularmente las asociadas con la organización; y, finalmente se presenta una propuesta de Tecnologías de Información y Comunicaciones (*TIC*) que se puede utilizar las organizaciones de acuerdo a la modalidad de *TT* que asuman.

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1. Introduction

At present, Telematics is applied in all modern production areas since it allows to propose solutions and services that are used both in telecommunications and in computer systems; from this point of view, its application can be found from a simple Internet connection, to a sophisticated distributed data transmission system.

It is for the foregoing that venture into the reflection on the effects to which an organization is exposed worldwide with respect to the infrastructure for the TT, involves developing the theme conceptually and then implement a model that facilitates people their foray into life work, without having to depend on the mobility times from their homes to the offices and taking advantage of the technological advances in telematics, as well as the theory and practice on the most comfortable ways to organize the times between dependencies with diverse activities and needs of the companies.

From this perspective, there are three different forms of TT:

- Autonomous Telecommuting: independent employees that use ICT to execute their tasks, performing them from any place chosen by them.

- Mobile Telecommuting: employees who perform all their activity from mobile devices or technology tools that adapt to their needs, no matter where they are.

- Supplementary Teleworking: employees who work, either from associated offices or the headquarters, but on specific days, and the remaining work without executing is done from another place, according to the comfort of the teleworker [1]

Consequently, TT involves the use of a set of technological resources that range from a simple call, to access to the different servers of the company through a Virtual Private Network (VPN); or through Cloud Computing or Cloud Computing - internet based computer system and remote data centers to manage information services and applications.

This is how, cloud computing allows consumers and companies to manage files and use applications without having to be installed on the computer, and with access to the Internet, access to infrastructure is also available.

What is more, Telematics offers communication and information possibilities, both at work and at home, because it groups very diverse services: telecopy,

teletext, or telematics networks that include the Internet. This is how, it covers a scientific and technological field of considerable scope, encompassing the study, design, management and application of communications networks as well as services for transport, storage and processing of any type of information such as: data, voice, video, among others. That is including the analysis and design of technologies and switching systems.

In agreement with the ideas exposed, the present document describes a state of art about the technologies that determine the infrastructure that is needed so that an organization implements the TT; and it establishes how Telematics becomes part of the development of this work modality because, as indicated, it allows connection through services and techniques where telecommunication and information converge.

This article is structured as follows: in the first section, the kind of reference made to the background of the TT; in the second one, it gives a description of the methods used in TT; in the third one, the telematics infrastructure analyzed for the TT, focusing on technological recommendations, solutions; and finally, it establishes a general approach to the implementation of TT solutions in accordance with the diversity of entities, where it is executed.

2. Background

Initially, we want to emphasize the importance of the evolution of Telematics for the development of TT, considering the term teleworking as: the professional activity carried out at a distance using telecommunications in the presence of the increase of the internet at company level, with which the TT grew as a form of employment [2].

That is to say, considering Telematics as the shared product of the development that telecommunications and information technology have achieved-hence, its name and next to the evolution of hardware and personal computers that. In addition, having accelerated the possibility of communication with other devices and computers located in the same physical area (through a cable, forming a network) or between different areas, it also has effectively potentiated the intercommunication with automatic systems of greater benefits by means of a telephone line [3].

Since then: the telematics civilization has been implemented in the areas of the teleschool, teleshopping, telebanking, teletext, teleprinted newspaper, videotex or

teleconference. In this way, the telematic network is being constituted as the new nervous system of post-industrial society [4].

On the one hand, the word Telework, etymologically, comes from the union between "telou from the Greek- and "tripaliare from Latin-, by what means: away and work, respectively. You can define teleworking as: a way of working remotely that allows you to work independently, doing the activity through technology and telecommunications -and to a greater extent- than in person [5]. The first appearance of the idea of the TT was registered in a cybernetics study published by the professor Norbert Wiener towards in 1965, where it indicated the possibility of realizing a work at a distance with the aid of the telecommunication and the computer science [6].

Now, in the USA the TT arose during the oil crisis of the 70s. This is how in this period the physicist Jack Nilles -of the University of Southern California- in 1973 proposed teleworking as a method of saving, reducing pollution and optimization of non-renewable resources. Nilles defined the term teleworking as: sending work to the worker instead of the worker, after which he created the concept of "telecommuting". It is also worth highlighting, in this first identified stage, the Hungarian engineer Peter Goldmark, who proposed to work in the city without leaving the field using telecommunications [7].

On the other hand, in the mid-seventies the transmission of files and the emergence of the system of distribution of hypermedia or hypertext documents interrelated and accessible via remo.

Wide Web, was consolidated in the year 1991-, as well as the advance of mobile applications, favored the conditions of the TT, [8]. This is how NeXTcube became the first web server in the world, working from March 1989 to December 1990, opening to the public on August 23, 1991 [9].

Now, the second period identified for the evolution of TT starts from the beginning of the 90s. This was characterized by the irruption of the personal computer (PC), and with it the distributed computing and the development of private virtual networks that were extending the concept of local network and generalizing the use of electronic mail. The TT thus, appears as an option to support business outsourcing. Towards the end of the 90s and of this stage, it evolves towards the so-called mobile office.

A third stage, from the first years of the 21st century until today, shows that teleworkers count for hundreds of thousands, not only in the US but also in Europe [10]. Currently, teleworking represents the spirit of the post-industrial era; This means, among other things, the improvement in the unit of time and place on which the Taylorist model of production was based, on account of the use of telematics technology [11]. In this sense, in addition to requiring a telecommunication system, the information and computer program used by the teleworker must transfer data easily and quickly. Such reality today implies the existence of two possible means of origin of the connections to carry it out: the basic telephone network (RTB), or the Integrated Services Digital Network (ISDN) [12].

Now, from the perspective of the individual, there are testimonies that reflect the prevailing need for connectivity; For example, in Spain, one of the teleworkers that began in 1994 with IBM comments on their experience indicating that it developed with the evolution of the different technological tools, reflected by the transition given by Figure 1:

Figure 1: Evolution of technological tools [13].

"I started telecommuting since 1994, for a company where we were very technological, about twenty, and we worked normally for IBM customers, who were in different places and we had to travel a lot. From the first day, I arrived there, I had a laptop and it connected me as I could " [13].

Spain as a European reference on the subject, promoted and developed teleworking from different approaches, such as:

- SYNERGY (where the creation of the European Forum on Telematics and Teleworking was recommended) [14].

- TELEURBA (where the relationship between road

traffic and teleworking was studied in four large European capitals, including Madrid) [15].

- PRACTICE (where recommendations were established for the regulation of teleworking by the Member States) [16].

- ATTICA (which contains a clear reference to the coordination of the national laws of the TT) [17].

- RACE (where advanced communications were developed) [18].

As a result, according to a study conducted by the Carlos III University of Madrid, the figures for teleworking as an employment modality are increasing: in the United States (25 %), the countries of northern Europe: The Netherlands (26 %), Finland (22 %), Denmark (21 %), Sweden (19 %), United Kingdom (17 %) and Germany (17 %). And you can see the existence of countries where the demand for teleworking is still low: Portugal (3 %) and France (6 %); the same study also shows how the interest of citizens for permanent teleworking in Europe is 40 %, while 52 % are favorable to working remotely one day a week [19].

From another point of view, in multinationals such as Cisco or Accenture, the necessary material is also provided to employees who wish to telecommute. These experiences began as a pilot project; but at this time, it has had growth prospects and continues to trend. Accenture, present in 48 countries, that indicates that the country with the highest boom in TT is Spain.

Moreover, the Japanese company Panasonic allows 30,000 of its workers to carry out their work from home two days a week, a trend followed on a smaller scale by the Toyota car company and other information technology companies in Asian countries where Teleworking is also used, but with better figures than in Spain [20].

Now, in Latin America, the economic crisis that occurred between 1998 and 2002, where the unemployment rate was higher than 20 %, allowed companies to think of different alternative models of organized employment to cut operating costs [21].

From this context, it can be explained that in mids-2016 Daniel Maurate - Minister of Labor and Employment Promotion of Peru - indicated that he would receive technical assistance from Korea in order to improve employment services, together with the fact that the Inter-American Bank of development (IDB) approved a loan for US $ 30 million - which will be used

to generate supply and labor demand - brought as a result strong indicators of inclusion: as of June 2016, 13 % of companies hire people with disabilities, and the projections are for the month of July would reach in the public sector to 5 %, "he specified. The above shows that when promoting TT, it is consolidated as a practice that is already common in the workplace [22].

Therefore, UNIDO (United Nations Organization for the Development of Industry) has supported the management that has been carried out with respect to ICT and employment. This is how, it created a program that encourages learning in this area, initially aimed at entrepreneurs.

As a consequence in Chile, at the end of the 20th century, the Telecommuting Program of the Canadian company Northern Telecom (today Nortel), developed and implemented the teleworking model at home. The company sent each new teleworker a package of equipment that included a computer, a telephone, a modem to access the telematics network, and a T-shirt with the name of the embroidered work program.

That is to say: the TT in the Latin American context has accelerated during the last five years; but, particularly, large Colombian companies have integrated it into their planning, as an issue that has been focused through the Ministry of Information and Communications Technology (MinTic); and in Bogotá with the High District Council of ICT. This helped to dispense the norm that protects the TT, promulgated in mid-2012 by the Presidency of the Republic -in conjunction with the Ministries of Labor and Information and Communications Technologies-. Decree 0884 would regulate Law 1221 of 2008, the process and procedure described below [23].

It should be noted, as background, that initially in 2008 and in cooperation with Hewlett Packard, a ICT training was developed in Colombia, establishing a model that created 33 centers in 11 countries, with which more than 18,000 students received training [24].

From this result, Law 1221 of 2008 constituted by three profiles or three modalities of teleworking: Autonomous, Supplementary, and Mobile.

In Colombia, both the public and the private sector have implemented the TT, so that from 2012 to 2016 there was an increase of 202 %. According to 1,740 surveys conducted: 15 % belong to large companies; 27 % corresponds to medium-sized companies; and to the small company 58 % [25].

Thus, in such period, studies were also conducted in different cities of Colombia verifying a significant increase in employees in TT, in three cities of them:

- Bogotá: it went from 23,485 to 55. 848

- Medellin: it went from 2,850 to 25,081

- Cali: it went from 3,012 to 5,723

It was also concluded that, the sector where this type of employment was most implemented corresponded to companies belonging to the service sector: 60 % are teleworkers.

Already by the beginning of 2017, in Bogotá, it was quantified that 58 % of the total teleworkers in the country were there. As a result, this figure doubled in four years: in 2012 there were barely 23,485, [26].

In another sense, understanding the TT as an inclusion modality of vulnerable sectors to the employment market, in Colombia and Latin America, inclusive projects using technology have been developed. As a result of these efforts, there are developments such as Convertic (MinTic digital tool for the blind), [27]. In Argentina, training and special courses are also being carried out on the management of ICTs aimed at people with disabilities to increase their possibilities of hiring under the TT modality. And in Guatemala, vulnerable persons have been incorporated into the TT, particularly those that belonging to indigenous communities [28].

On the top of that, in Colombia there are about 10,739 companies that have TT; as well as 95,439 remote workers. The goal, according to the MinTic, is to reach 120 thousand teleworkers by 2018, so that the Ministry of ICTs will hold TT workshops in different cities such as Bogotá, Cucuta, Barranquilla, Popayan and Medellin, [29]. The goal is that by the middle of that year, 90,000 places will be opened for citizens who want to access free training in which they will receive advice on different topics such as: legislation, operation of the professional risks insurer and pensions, among other aspects of the TT. Of these 90,000, about 30,000 citizens will be trained in Bogotá [30].

Derived from this consolidation of the TT, at the beginning of 2017 - during an event in a populous place in the Colombian capital - a memorandum of understanding was signed with the Mayor's Office of Bogotá and Microsoft to implement a mass teleworking plan. The president of Microsoft, Marco Casarín, connected through a video conference from Cartagena, took the opportunity to announce that the company will expand its software donation program, which includes cloud services such as Azure and Office 365, to the Community Action Boards, JAC of the capital [31].

3. Materials and methods.

After considering the TT phenomenon from different places in the world, the TT infrastructure will be adopted as research object: For which the following methodology will be followed: the Telematics Infrastructure for the TT is initially described; then support technologies will be identified; subsequently the needs demanded by these technologies; and finally, an infrastructure model will be proposed according to the size, type and modality of TT.

The validation of this methodology was provided by experts from the METIS research group.

3.1. Telematic infrastructure for telework

The set of fundamental technologies for the development of teleworking are: applications, contents, devices, and infrastructure, are of capital importance since, when integrated, they generate favorable spaces for TT. Figure 2.

Figure 2: Technologies for Teleworking.

Source: own

The trend that is being imposed in terms of teleworking devices is centered on Bring Your Own Device (BYOD): equivalent to: "bring your own device". That is: where the devices that each worker has (laptop, smart phone or Smartphone, tablet, among others) are used, connecting them through secure systems that allow the organization to reduce the investment in technology of their property.

It must be taken into account that not all technology is suitable for teleworking; The majority of operating systems, programs and applications that make today's organizations work are easily adaptable to a collaborative work model through virtual servers (cloud computing), see Figure 3.

Figure 3: Cloud computing.

Source: own

Understanding that technology is unavoidable to be able to Telework, it does not mean that you should have the most expensive and advanced hardware, equipment or software. Enough with having a telephone line; but the most sophisticated infrastructure can be used to safeguard information and telecommunications. The fundamental thing is that the technology is adjusted to the needs of the teleworker, and not that he has to abide by it. In addition, there is no single technology for teleworking, what exist are elements to form what could be called a Digital Ecosystem, where everything works in a coordinated manner, which implies that applications must be on services, ie: it is necessary an infrastructure where the physical elements that allow digital connectivity are found. One example is fiber optic networks with services offered by operators that make use of the infrastructure, allowing digital connectivity with internet services, mobile telephony, and text messaging, among others. Meanwhile, applications are used to interact with the end user - such as remote access to databases - and friendly interfaces where the end user of the infrastructure does so directly or indirectly, as well as services and their applications, in a transparent way.

In accordance with the foregoing, the following technological recommendations, Figure 4, are made to be implemented by the institutions in order to minimize the mishaps of the teleworker while complying with the tasks assigned.

Figure 4: Technological recommendations.

Source: own

3.2. Technologies for teleworking

After general recommendations, it is an immediate matter to verify that teleworkers have an environment that resembles their office; while some of them work in a semi-permanent place, in most cases from their own residences, others are mobile teleworkers, who in turn, require the necessary connection facilities to the resources of their office from the mobile devices with which count.

However, providing remote access to company data and services from a residential environment or from mobile devices poses challenges for both the worker and the organization's technology team [32].

For the teleworker it is important to use the resources and information of the company in a reliable and permanent way. To this must be added that technological solutions for teleworking must support a high variety of demands and types of access depending on the differences between skill levels and knowledge of technology, which requires that the procedures and devices that allow access to the corporate environment is well defined and easy to manage, ensuring constant data connectivity.

The widespread growth of the Internet; the promotion of the use and appropriation of ICT; the development of the Digital Ecosystem - suggested, for example, the model of the Plan Vive Digital - through what is shown below in Figure 5, [33].

As a result, there is no single technological scenario for teleworking. What we do have is a series of criteria to improve the technological resources of teleworkers, where each organization must conceive:

1. Infrastructure: Includes the physical means to transmit, emit or receive, signs, signals, text, still

or moving images, sounds or data of any nature, between two or more geographical points at any distance through cables, radioelectricity, optical means or other electromagnetic means [34].

2. Services: They are offered by the operators or ISP (Internet Service Provider), making use of the infrastructure to develop digital connectivity: the Internet service, the mobile telephone service, the text message service (SMS) , Hosting services, or cloud services [35].

3. Applications: make use of the services to interact: the teleworker with his employer, the work team and / or the systems of the organization; In short: they are those that allow file sharing, make presentations, use audio-response systems for mobile telephony or mobile banking for SMS service; or simply control time [36].

4. Users: they make use of the applications and indirectly of the services and infrastructure to consume and produce digital information: people who use the internet, cellular telephony or any other means of digital communication.

Figure 5: Components of the Digital Ecosystem.
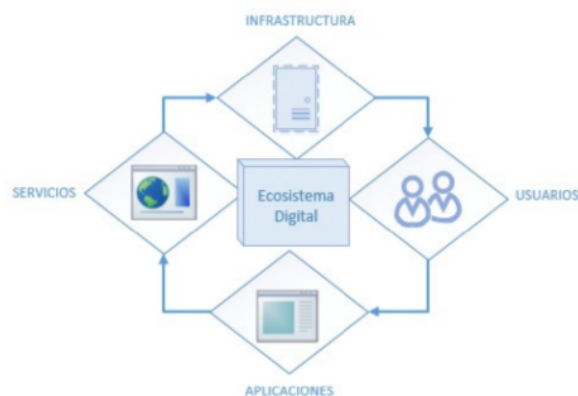
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At this time, there are multiple options to address the needs of treating information remotely or remotely to the entities that host teleworking; so it is important that the technology area knows widely the variety of alternatives and choose the one that best suits the specific need of the organization.

The solutions that include telecommunications and information technology, in other words, the telematics component that is the object of the article, will be described.

3.2.1. Telecommunications

Recognized as the set of techniques that allow communication at a distance, including short and long; they have been seen to evolve rapidly since their appearance - at the end of the 19th century - with the invention of the telegraph and the creation of new technologies. Its importance for the TT lies in the fact that it is the module in charge of establishing the connection between the teleworker and the institution [37].

Among the types of telecommunications solutions are wired systems; fiber systems; the radio systems; satellite systems; and mobile communications systems. The telecommunications media landscape can be grouped into fixed transmission media and mobile transmission media (Figure 6).

Figure 6: Telecommunications.
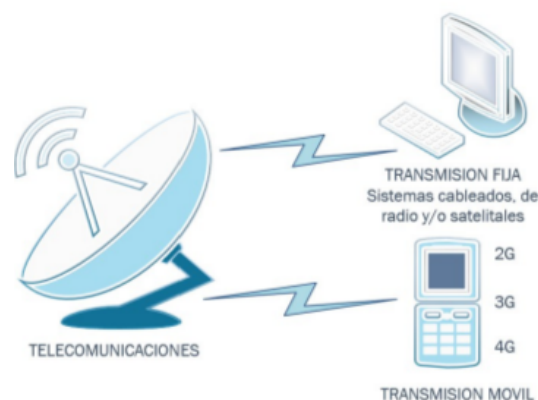
Source: own

3.2.1.1.Fixed transmission media

These fixed networks transport data, voice and video usually to the organization. They use different technologies for which the priority is a greater Bandwidth. The technologies used are:

- **Wired Systems**

  Originally they belonged to telephone networks where only voice was transmitted, but with the arrival of the internet and the modem, the sending and receiving of data with low speeds and long waiting times was achieved. It was advanced at high speeds that allowed remote desktop management in real time, IP voice calls, among others.

  At present, wired systems reach most major and intermediate cities, including homes, there

are different ways of interconnection. Coaxial cables, copper pairs and fiber optic cables, which in addition to telephony and internet transport television in different qualities and speeds according to the medium used.

- **Radio Systems**

Normal radio communication systems consist of two basic components, the transmitter and the receiver. The first generates electrical oscillations with a radio frequency called carrier frequency. The coverage or the frequency itself can be amplified to vary the carrier wave. Radio links are a connection between different telecommunications equipment using electromagnetic waves. A radio link consists of a small radio transmitter (TX) that sends the signal to a receiver (RX) that are geographically distant, both with their respective antennas. Normally these links use frequencies between 800MHz and 42GHz.

They are perfect for establishing connection between sites where the difficulties of distance, topography, access or other physical factors prevent the rapid and / or adequate implementation of a wired transmission medium, offering a fast and effective alternative.

The current radio systems, with a single communication tower, provide services to multiple users at the same time with point-to-multipoint links.

- **Satellite Systems**

They have always been an effective option for communicating organizations with remote or inaccessible sites, where wired networks and even radio systems are not financially and / or technically viable. Its implementation is not massive, since when comparing with other systems these turn out to be the most expensive. They use satellites that are either geostationary or orbiting.

Additionally, in geostationary systems, satellites remain in a fixed position relative to a given geographical situation (the satellite is actually in a fixed orbit that moves maintaining a stable relationship with the earth). On the one hand, with this type of system, the satellite is able at all times to receive and transmit messages to any transmitting or receiving equipment that is

within the geographical area permanently visible by the satellite. Geostationary satellite-based communications systems may have more than one satellite in order to cover a greater percentage of the Earth's surface.

On the other hand, the orbital communication satellites move within an orbit so that the satellite passes over a given geographical situation at regular intervals. Such systems entail that terrestrial transmitting or receiving equipment are only within the range of the satellite at periodic intervals, and are able to transmit or receive only when they are within the coverage of the satellite, or in other words, when the satellite is visible. The transmitting equipment can store the messages until the satellite passes. When messages are transmitted to the satellite, they can also be stored there until the satellite enters the coverage area of a ground receiving station. Unlike geostationary systems, a single satellite could in fact cover the entire surface of the earth.

Apart from the cost of implementing a satellite service, it must be borne in mind that they have low capacity for data transmission and the delays proportional to the distance that the waves must travel reduce the quantity and quality of services that can be offered and the number of users to attend But it must be emphasized that these networks provide services in places where no other means could reach.

3.2.1.2. Mobile transmission media

These types of transmission are born in response to the demand to keep human beings communicated anywhere and, above all, in movement.

In its first generation, mobile services only consisted of telephony for voice transmission. Their constant evolution has led them to transmit data and video thanks to the greater capacity in the bandwidth that allows teleworkers to have all the services to accomplish their tasks without the need to be connected to a fixed network.

What is more, with cellular telephony, the radio network is used, where the device is in motion and the other end of the channel is a cell. Multiple cells allow to establish the coverage areas through which it is possible to move and have voice, data and / or video connection.

The new generations of 3G and 4G mobile networks were designed to provide multiple services on a single platform.

3G networks provide voice and data with speeds from 0.2 Mbps (millions of bits per second). Its advanced versions use HSDPA for its acronym in English (High Speed Downlink Packet Access) also known as 3.5G or 3G +, whose download rates are up to 14Mbps. Finally, we have the 4G -or fourth generation- that are even faster than Wi-Fi connections in homes reaching speeds of up to 100 Mbps, allowing versatility of services for teleworkers.

With satellite networks you can also have mobile communications with lower bandwidth but having access to most of the planet.

Cellular networks and their devices have evolved rapidly so much that the cell phone became a smartphone - or smartphone - with features and functions like those of a laptop.

3.2.2. Computer infrastructure

The IT infrastructure consists of a set of physical devices and software applications that are required to operate an entire TT company. However, the IT infrastructure is also a set of services throughout the organization, budgeted by the administration and covering both human and technical capacities. It is of utmost importance in the TT since it allows to operate the different information systems, as well as the storage of data. It must be adjusted depending on the needs of each company: level of confidentiality, access to resources, availability and technical capacity of it.

Among the types of computer infrastructure for teleworking are: data center, shared data centers and cloud computing.

- **Data center**

  The data centers - or Data Center - are physical spaces where the environmental, electrical and safety conditions are facilitated for the proper functioning of the computer equipment and storage of data that are housed there. Organizations or companies use to organize, process, store and disseminate large volumes of information. They host the most critical systems of a network and are vital for the continuity of the critical processes of the institution. A Data Center is not a single isolated element, it is a set of elements that serve as main repositories for all types of computing

devices, including servers, storage subsystems, network switches, routers and firewalls (firewalls); as well as the wiring and physical frames used to organize and interconnect the servers. The teleworker usually makes use of these equipment when it enters the services and applications that are hosted on the servers through the communication channels.

The data center must have an infrastructure that ensures that the equipment installed there is operable preferably 24 hours a day, since it depends on this that users can access the services and information that are offered there. For this reason, it is advisable to have a backup or alternate data center, which in case of problems or catastrophic events allows to maintain the provision of the service to the users of the entity.

- **Shared data center**

An available space -with costs or complexity to install and maintain a proper data center- gives rise to the appearance of shared data centers, which allow entities to have a safe environment without having to build their own center of data to meet the needs of teleworkers.

In the shared data centers it is possible to access services such as Colocation and Hosting:

- Colocation: it consists in having a physical space with all the necessary characteristics so that the servers and storage systems of the entity are physically hosted there.
- Hosting: is a service which both the space on the server (s) are provided by the ISP provider Ïnternet Service Provider.ºr the shared data center.

Furthermore, within the evolution of the telematics infrastructure, virtualization systems appear, which make it possible to expand the offer of shared services and improve their security. In this sense, virtualization is the creation -through software- of a virtual version of some technological resource, such as a hardware platform, an operating system, a storage device or other network resources [38]. Each virtual server behaves like a physical server in front of the applications and services it contains. In this way, several virtual servers configured in different ways in a single physical server allow to multiply the processing capacity of the server: instead of needing a physical server for each application, a

virtual one can be created, optimizing the use of resources.

- **Cloud Computing**

Cloud computing was born from the robust technologies that are currently used for telecommunications. They are services and applications from the Internet that are in charge of handling requests at any time without the need of having your own data center. You can access your information, application and service through an internet connection from any mobile or fixed device located anywhere. They serve their users from several hosting providers frequently distributed, including, all over the world. This measure reduces costs, guarantees a better uptime, and provides security to websites, making them less vulnerable to hackers, local governments, and untimely raids.

This new paradigm facilitates the telematics infrastructure in the organization that hosts it, so that maximum use is made of virtualization, and the replication of data.

There are 3 types of services in cloud computing:

- **SaaS: Software as a Service**

Since the engineers realized that it was cheaper to run applications in a data center and distribute them to client terminals, the software became a service. That is to say, an organization when buying software does not necessarily have to install it in its terminals or in its server; In this case, you use it with your Internet connection and, most importantly, you can extend the service without changing or having to buy a new infrastructure. Many are counted as: Salesforce, Basecamp, among others.

- **IaaS: Infrastructure as a Service**

Infrastructure as a service is provided under a virtualization platform. Instead of acquiring servers, physical space in a data center, or network equipment, customers buy all these resources from an external service provider. Many are counted as: Amazon Web Services EC2 and GoGrid, among others.

- **PaaS: Platform as a Service**

Platform as a Service. It is usually seen as an evolution of SaaS, but it is -more- a service in which the sum of the previous two is offered to support the complete life cycle of construction and implementation of web applications and services completely available on the Internet. . Another important feature is that there is no software download to install on the computers of the developers. PasS offers multiple services, but all provisioned as an integral solution on the web. Many are counted as: SimpleDB, SQS, Google App Engine, among others [39].

3.2.3.   User devices

- **Virtual desks**

The virtual desktop expands the possibility for user devices since it consists of the simulation of a complete PC environment, without the need to associate it with a physical device, which is accessed by using an Internet browser.

Therefore, the virtual desktop market is useful for users - with Internet access - who travel permanently or who need to optimize their time, money and / or space; it is here where the remote control software plays a fundamental role. In this sense, the virtual desktop has allowed teamwork to be more fluid among employees who decide to work from home with employees who are in the offices [40].

- **BYOD (Bring Your Own Device)**

As indicated above, a new trend in recursivity of technological equipment is that each teleworker uses his own devices to perform the assigned tasks; the choice of each worker is determined to increase the productivity associated with the comfort and familiarity of working with the technology with which he is accustomed.

The BYOD, obeys to scenarios such as:

- Reduction of the time required to become familiar with the use of the devices.
- Use of multiple devices by the worker: laptop in the office, desktop at home, smartphone on the street.

Difficulty to provide each worker with the appropriate device or with the one he likes.

Although BYOD brings advantages to entities, it also poses challenges in terms of infrastructure support and maintenance and, of course, security of information, especially the risks of exposure to viruses or loss information due to loss or absence of security in the devices.

Additionally, the safe way to use user equipment in BYOD in teleworking models is guaranteed from the implementation of virtual desktops. In this case, the devices of the teleworker will not lodge information of the organization and can be accessed no matter from which device the worker connects, thereby achieving security for the entity by providing the use of various devices from any location.

3.2.4. Applications

This element constitutes the interaction of the and with the teleworker to carry out his work for the organization. In this sense, there are multiple applications that can be used for teleworking and can be found for free, here are some:

- **Applications for communication:**

  There are instant messaging systems, email, video conferencing, you can find applications like: WhatsApp, Hangouts, Skype, Messenger, NetMeeting, Webex, among many.

- **Support and Sharing applications:**

  These applications save time since it is not necessary to travel for the task mode in TT; can facilitate the transfer of files between computers that are in the company and at home; make an online presentation; enable a virtual training sharing with other people the desktop where different actions are executed; some of these applications are: TEAMVIEWER, JOINME, AMMY ADMIN, TIGHTVNC, SHOWMPC, MICROSOFT REMOTE, CHROME REMOTE, among many more.

  - Teamviewer provides full remote support without the need for installation, it is free for non- commercial use.
  - Joinme is a very simple application: several people can connect simultaneously - up to 5 people to the same computer in the free version.
  - Ammy admin: easily share a remote desktop or control a server over the Internet. No

matter where you are, the application offers easy and secure access to a remote desktop in just a few seconds, it's free for non-commercial use.

- Tightvnc: is one of the simplest options to connect to another computer within the same network. It is not the only VNC client that can be used, although others offer similar solutions. It will also work when the ports on the router have been opened and the public IP connection is known, or you have a solution without having an open source fixed IP.
- Showmpc: it is free for domestic use, and for business networks it offers payment plans with access to more equipment and advanced functionalities; if you want to access a computer with a Windows operating system, it has an easy-to-use executable. For those who use Linux or Mac, has a solution designed to work through Java.
- Microsoft Remote: application that Microsoft has to access from Android devices and also iOS, allowing access and control of computers with Windows. It is a direct connection, no need to install something on the client's computer.
- Chrome Remote Desktop: is the Google alternative to remotely access a computer through your browser, for which it is necessary to install an extension. It is designed, above all, to support teams with Google Chrome OS [41],

Finally, there are also tools such as Dropbox. Basically it is a storage service in the cloud, completely free, that allows to store and synchronize all types of documents through the Internet [42].

Google Drive: it is the place where all the files are accessed, including the Google Docs and the local files that Google uses to store all types of files: documents, presentations, music, photos and videos [43].

- **Document Management Applications:**

  It is necessary to keep control of the documentation in the companies, regardless of the work modality, as well as to carry out queries of already digitized information and save the generated documents, make version control, disseminate remote publications; for which there are different

tools such as Nuxeo, Alfresco, Athento, among many others.

3.2.5. Security

Security is perpendicular to all types of teleworking. It is perhaps the most important aspect to take into account when you are going to implement this work modality. Computer security, regardless of the sector, size or type of information handled in each entity, is a critical issue.

To carry out a correct implementation in security, it is recommended to base it on the Colombian Technical Standard NTC -ISO / IEC 27001, elaborated to offer a model for the establishment, implementation, operation, follow-up, revision, maintenance and improvement of a Security Management System of Information -SGSI-. The requirements established in this standard are generic and are intended to be applicable to all institutions, regardless of their size, type and / or nature.

For the above, it is used, among other successful, Evernote, application that allows to translate ideas at the moment, enrich them with images and group them by themes [44].

In line with the above, it is important to have an Information Security Policy manual, if the whole 27001 norm is not applied. And if you are going to make connections to servers remotely, at least use a VPN and minimum security that she demands [45].

From this perspective, the fact that the information of the entity begins to be consulted remotely, and even from devices belonging to each teleworker, involves a series of risks due to loss of data or leaks to them, which is why it is It is necessary to take the necessary considerations when adopting the model [46].

That is, the security of information is based on preserving the following aspects:

- Confidentiality: ensuring that only authorized persons have access to the information.

- Availability: ensuring that the information can be accessed at the required time.

- Auditability: that is guaranteed to have control by recording all the events.

- Non-repudiation: guarantee that neither sender nor receiver can deny a flow of information to third parties.

- Integrity: guarantee the non-alteration of the information by third parties.

- Authenticity: guarantee the validity of the information and its origin, avoiding impersonation.

- Legality: guarantee of compliance with the rules and laws to which it is subject.

3.3. Identification of technological needs

It is important to know the needs of the institution to adopt the appropriate technology; whether they are private or public entities that share needs; as well as identifying the profile of the teleworker.

As a checklist, you can ask some questions like the following to identify the profile:

- What is the work that the teleworker is going to do remotely?

- How will the teleworker access the systems of the organization?

- Type of work to be done remotely?

- How will communication be established between the teleworker and the work team?

- What kind of security should the system have?

- How will the teleworker be supported?

- What applications will the teleworker use and which databases will he be able to access? [47].

3.4. Identification of technological solutions

- Required applications: establishing what applications the teleworker will use.

- Suitable devices: depending on the applications, choose the appropriate device (s).

- Media: depending on the devices, which means of connection will be used.

- Infrastructure: depending on the applications, the connection and the devices, the structure is defined.

- Channel: taking into account the infrastructure of the number of teleworkers, the capacity of the channel is defined.

- Security: According to the infrastructure and the applications to be handled, the type of security for the organization is defined.

In the following Figure **7**, the variety of devices and software that can be used for telecommuting is identified.

Figure 7: Technological Solutions for Teleworking.

Sistema de Telefonía	⟶	• Telefonía IP • Comunicaciones Unificadas
Sistema de Videoconferencia	⟶	• Audio • Video
Virtualización de Escritorios	⟶	• Movilidad • Disponibilidad de la Información • Seguridad
Acceso a Bases de Datos y Sistemas de Información	⟶	• Redes VPN • Navegadores de Internet
Sistemas de Telepresecencia	⟶	• Video HD • Presencia Virtual
Software de Colaboración	⟶	• Seguimiento • Trabajo Colaborativo
Correo Electrónico Corporativo	⟶	• Comunicación Bidireccional • Seguridad

Soluciones Tecnológicas para el Teletrabajo

Source: own

Table 1: Autonomous teleworking.

AUTÓNOMO			
ENTIDADES PUBLICAS	**Basico**	**Intermedio**	**Avanzado**
Telecomunicaciones de la entidad	• Canal de Internet dedicado 0,4 Mbps por teletrabajador	• Canal de Internet dedicado 0,7 Mbps por teletrabajador • Planes de telefonía móvil corporativa • * Sistema de telefonía IP	• Canal de Internet dedicado 1 Mbps por teletrabajador • Planes de telefonía móvil corporativa • Sistema de telefonía IP
Telecomunicaciones del teletrabajador	• Canal de Banda Ancha 2Mbps • Línea telefónica	• Canal de Banda Ancha mayor a 4 Mbps • *Plan de datos Internet móvil • *Plan de telefonía móvil	• Canal de Banda Ancha mayor a 10 Mbps • Plan de datos Internet móvil • Plan de telefonía móvil
Infraestructura	• Centro de datos	• Centro de datos • Servicios de nube privada	• Centro de datos • Servicios de nube privada • Servicios de nube pública
Dispositivos	• Teléfono fijo • Computador	• Computador de escritorio o portátil • Softphone • Teléfono Inteligente • Tableta	• Computador de escritorio o portátil • Teléfono IP • Teléfono Inteligente • Tableta • Terminal de videoconferencia
Aplicaciones	• E-mail o correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc	• E-mail o correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo	• E-mail o correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo • Sistema de comunicaciones unificadas • Sistema de colaboración
Seguridad	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio)	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto • Cifrado de datos	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto • Cifrado de datos • Múltiple factor de autenticación

Source: own

3.5. Implementation of technological solutions.

- **Public entities**

Given that public entities have, in general, a large number of workers that can be geographically distributed in a territory, it is important to take into account the type of connection and the band to ensure that the teleworker can fulfill their functions efficiently. For this, it is recommended to attend the aspects defined in tables **1**-**3**: Autonomous Teleworking; Supplementary Teleworking; and Mobile Teleworking, respectively [47].

Table 2: Supplementary teleworking.

SUPLEMENTARIO			
ENTIDADES PUBLICAS	**Basico**	**Intermedio**	**Avanzado**
Telecomunicaciones de la entidad	• Canal de Internet dedicado 0,2 Mbps por teletrabajador	• Canal de Internet dedicado 0,4 Mbps por teletrabajador • Planes de telefonía móvil corporativa	• Canal de Internet dedicado 0,6 Mbps por teletrabajador • Planes de telefonía móvil corporativa • Sistema de telefonía IP
Telecomunicaciones del teletrabajador	• Canal de Banda Ancha 1Mbps • Línea telefónica	• Canal de Banda Ancha mayor a 2 Mbps • Plan de datos Internet móvil	• Canal de Banda Ancha mayor a 4Mbps • Plan de telefonía móvil
Infraestructura	• Centro de datos	• Centro de datos • Servicios de nube privada	• Centro de datos • Servicios de nube privada • Servicios de nube pública
Dispositivos	• Teléfono • Computador	• Computador • Teléfono Móvil	• Computador • Teléfono Móvil • Softphone • Tableta • Escritorio Virtual
Aplicaciones	• E-mail o correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc	• E-mail o correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo	• E-mail o correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo • Sistema de comunicaciones unificadas • Sistema de colaboración
Seguridad	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto • Cifrado de datos	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto • Cifrado de datos • Múltiple factor de autenticación

Source: own

- **Large Companies or Private Sector**

So given that private entities have a large number of workers, which can be distributed in an urban, national or international area, it is important to take into account the means of communication and the bandwidth to ensure that the teleworker can efficiently perform their duties. To do this, it is recommended to address the aspects defined in tables **4**-**6**: Autonomous Teleworking; Supplementary Teleworking; and Mobile Teleworking, respectively.

Table 3: Mobile Teleworking.

MOVIL			
ENTIDADES PÚBLICAS	**Basico**	**Intermedio**	**Avanzado**
Telecomunicaciones de la entidad	• Canal de Internet dedicado 0,2 Mbps por teletrabajador	• Canal de Internet dedicado 0,4 Mbps por teletrabajador	• Canal de Internet dedicado 0,6 Mbps por teletrabajador
Telecomunicaciones del teletrabajador	• Plan de datos internet movil	• Plan de telefonia movil • Plan de datos Internet móvil	• Plan de telefonia movil • Plan de datos Internet banda ancha móvil
Infraestructura	• Centro de datos	• Centro de datos • Servicios de nube privada	• Centro de datos • Servicios de nube privada • Servicios de nube pública
Dispositivos	• Computador portátil con modem • Tableta con plan de datos	• Computador portátil con modem • Tableta con plan de datos • Telefono inteligente con plan de datos	• Computador portátil con modem • Tableta con plan de datos • Telefono inteligente con plan de datos • Escritorio Virtual
Aplicaciones	• E-mail o correo Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc	• E-mail o correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo	• E-mail o correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo • Sistema de comunicaciones unificadas • Sistema de colaboración
Seguridad	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Cifrado de datos	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Cifrado de datos • Múltiple factor de autenticación

Source: own

Table 4: Onomous Teleworking.

AUTÓNOMO			
GRANDES EMPRESAS	**Basico**	**Intermedio**	**Avanzado**
Telecomunicaciones de la entidad	• Canal de Internet dedicado 0,4 Mbps por teletrabajador	• Canal de Internet dedicado 0,7 Mbps por teletrabajador • Planes de telefonía móvil corporativa • Sistema de telefonía IP	• Canal de Internet dedicado 1Mbps por teletrabajador • Planes de telefonía móvil corporativa • Sistema de telefonía IP
Telecomunicaciones del teletrabajador	• Canal de Banda Ancha 2Mbps • Línea telefónica	• Canal de Banda Ancha mayor a 4 Mbps • Plan de datos Internet móvil • Plan de telefonía móvil	• Canal de Banda Ancha mayor a 10 Mbps • Plan de datos Internet móvil • Plan de telefonía móvil
Infraestructura	• Centro de datos	• Centro de datos • Servicios de nube privada	• Centro de datos • Servicios de nube privada • Servicios de nube pública • Centro de datos alterno
Dispositivos	• Teléfono fijo • Computador	• Computador • Softphone • Teléfono Inteligente • Tableta	• Computador • Teléfono IP • Teléfono Inteligente • Tableta • Terminal de videoconferencia
Aplicaciones	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de colaboración • Sistema de comunicaciones unificadas • Sistema de flujo de trabajo • Redes sociales corporativas
Seguridad	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto • Cifrado de datos	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto • Cifrado de datos • Múltiple factor de autenticación

Source: own

Table 5: Technological Solutions for Teleworking.

SUPLEMENTARIO			
GRANDES EMPRESAS	**Basico**	**Intermedio**	**Avanzado**
Telecomunicaciones de la entidad	• Canal de Internet dedicado 0,2 Mbps por teletrabajador	• Canal de Internet dedicado 0,4 Mbps por teletrabajador • Planes de telefonía móvil corporativa	• Canal de Internet dedicado 0,6 Mbps por teletrabajador • Planes de telefonía móvil corporativa • Sistema de telefonía IP
Telecomunicaciones del teletrabajador	• Canal de Banda Ancha 1Mbps • Línea telefónica	• Canal de Banda Ancha mayor a 2 Mbps • Plan de datos Internet móvil	• Canal de Banda Ancha mayor a 4Mbps • Plan de telefonía móvil
Infraestructura	• Centro de datos • Servicios de nube pública	• Centro de datos • Servicios de nube privada • Servicios de nube pública	• Centro de datos • Servicios de nube privada • Servicios de nube pública • Centro de datos
Dispositivos	• Teléfono • Computador	• Computador • Teléfono Móvil	• Computador • Teléfono Móvil • BYOD (Dispositivo propio) • Softphone • Tableta • Escritorio Virtual
Aplicaciones	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo • Sistema de comunicaciones unificadas • Redes sociales corporativas • Sistema de colaboración
Seguridad	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto • Cifrado de datos	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto • Cifrado de datos • Múltiple factor de autenticación

Source: own

Table 6: Mobile Teleworking.

MOVIL			
GRANDES EMPRESAS	**Basico**	**Intermedio**	**Avanzado**
Telecomunicaciones de la entidad	• Canal de Internet dedicado 0,2 Mbps por teletrabajador	• Canal de Internet dedicado 0,4 Mbps por teletrabajador	• Canal de Internet dedicado 0,6 Mbps por teletrabajador
Telecomunicaciones del teletrabajador	• Plan de datos internet movil	• Plan de telefonia movil • Plan de datos Internet móvil	• Plan de telefonia movil • Plan de datos Internet banda ancha móvil
Infraestructura	• Centro de datos • Servicios de nube privada	• Centro de datos • Servicios de nube privada • Servicios de nube pública	• Centro de datos • Servicios de nube privada • Servicios de nube pública • Centro de datos alterno
Dispositivos	• Computador portátil con modem o Tableta con plan de datos	• Computador portátil con modem o Tableta con plan de datos • Telefono inteligente con plan de datos	• Computador portátil con modem o Tableta con plan de datos • Telefono inteligente con plan de datos • Escritorio Virtual • BYOD (dispositivo propio)
Aplicaciones	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de comunicaciones unificadas • Sistema de colaboración	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de flujo de trabajo • Sistema de comunicaciones unificadas • Sistema de colaboración • Redes sociales corporativas
Seguridad	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Sistema de copia de respaldo remoto	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Cifrado de datos	• VPN o Red Privada Virtual • Sistema de gestión remota de PC (antivirus y soporte de escritorio) • Cifrado de datos • Múltiple factor de autenticación • Sistema de respaldo remoto

Source: own

- **SMEs**

SMEs are the medium or small companies that have no more than 250 workers and moderate turnover. Given that in this type of organization the personnel is small, and that it does not have a robust infrastructure, it is not necessary to carry out a large technological deployment in the connection medium and in the bandwidth so that the teleworker can fulfill his tasks efficiently. . Trello or Basecamp, are some of the tools that facilitate and cheapen the technological challenge that supposes for a Pyme to bet on the TT. Another point to take into account is, the ability of SMEs to connect, compete and adjust to change. In this framework, the possibility of mobile connection through high- speed technologies such as LTE allows greater benefits to this type of companies. It should be noted that by 2020 Latin America will have 259 million LTE lines; according to Ovum data reflected by 4G Americas [48, 49].Pymes (Tables **7-9**)

Consequently, the TT is in a process of continuous development, not only in Colombia but in Latin America. Different ways and methodologies are adopted but with the same purpose. Both for the public and private sectors, the outlook is positive, especially considering that several cities -specifically from Colombia- advanced in the contextualization and implementation of this way of working- In addition, state support through the Ministry of Technology of the Information and telecommunications of Colombia. At present it is, therefore, easier to find detailed information -both at the technological and legal level- for the implementation of this work modality. But it is a consensus also to indicate that it is not enough, it is known that to achieve success it is necessary to have quality connectivity of the different actors of the model, if you want to have a market that aspires to further promote the TT.

In perspective, and in the face of technological development, there is a wide variety of applications and technologies that are available in the market, but the use of free applications is recommended - as far as the needs of the organization and teleworkers are concerned - since It depends on the economic resources of the organization as well as the conditions of the teleworker.

The telematics infrastructure that a teleworker needs is increasingly available; devices such as: Smartphone, Personal computers; and home connections such as: ADSL, FO, copper and Data Plans.

Table 7: Autonomous Teleworking.

AUTÓNOMO			
PYMES	**Basico**	**Intermedio**	**Avanzado**
Telecomunicaciones de la entidad	• Canal de Internet dedicado 0,2 Mbps por teletrabajador	• Canal de Internet dedicado 0,4 Mbps por teletrabajador • Sistema de telefonía IP	• Canal de Internet dedicado 0,5 Mbps por teletrabajador • Planes de telefonía móvil corporativa • Sistema de telefonía IP
Telecomunicaciones del teletrabajador	• Canal de Banda Ancha 2Mbps • Línea telefónica	• Canal de Banda Ancha mayor a 4 Mbps	• Canal de Banda Ancha mayor a 10 Mbps • Plan de datos Internet móvil • Plan de telefonía móvil
Infraestructura	• Todos los servicios de nube publica	• Todos los servicios de nube publica • *Servicios de colocacion en centro de datos compartido	• Servicios de nube publica • *Servidor en centro de computo local
Dispositivos	• Teléfono fijo • Computador	• Computador de escritorio o portátil • Teléfono IP	• Computador de escritorio o portátil • Teléfono IP • Teléfono Inteligente •BYOD (Dispositivo propio)
Aplicaciones	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Skype, Hangouts, etc	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Sistema de manejo de tiempo • Video chat multiple • Sistema de colaboración
Seguridad	• N/A	• VPN o Red Privada Virtual • Sistema de copia de respaldo remoto	• VPN o Red Privada Virtual • Sistema de copia de respaldo en la nube • Escritorio Virtual

Source: own

Table 8: Supplementary Teleworking.

SUPLEMENTARIO			
PYMES	**Basico**	**Intermedio**	**Avanzado**
Telecomunicaciones de la entidad	• Canal de Internet dedicado 0,5 Mbps por teletrabajador	• Canal de Internet dedicado 1 Mbps por teletrabajador • Sistema de telefonía IP	• Canal de Internet dedicado 0,4 Mbps por teletrabajador • Sistema de telefonía IP
Telecomunicaciones del teletrabajador	• Canal de Banda Ancha	• Canal de Banda Ancha mayor a 4 Mbps • Plan de telefonía móvil	• Canal de Banda Ancha mayor a 5 Mbps • Plan de telefonía móvil
Infraestructura	• Todos los servicios de nube publica	• Todos los servicios de nube publica • Servicios de colocacion en centro de datos compartido	• Servicios de nube publica • Servidor en centro de computo local
Dispositivos	• Computador • BYOD (Dispositivo propio)	• Computador portátil • BYOD (Dispositivo propio) • Teléfono inteligente	• Computador de escritorio o portátil • Softphone • Teléfono Inteligente •BYOD (Dispositivo propio) • Escritorio Virtual
Aplicaciones	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • Sistema de colaboración	• Correo electrónico • Telegram, WhatsApp, Line, Hangouts, etc • DropBox, Drive, OneDrive, etc • Video chat multiple • Sistema de colaboración
Seguridad	• N/A	• VPN o Red Privada Virtual	• VPN o Red Privada Virtual • Escritorio Virtual

Source: own

4.   Results and Conclusions

Teleworking is a figure that starts getting involved in society as a consequence of the technological explosion of the post-industrial era.

Table 9: Technological Solutions for Teleworking. Own.

Source: own

Due to the existence of a diversity of types of companies since each of them has different characteristics of infrastructure and resources, it is necessary to identify the technologies that can be used for teleworking, in this way it will be possible to obtain better results: economic, productive, Software easier to use and Hardware easier to obtain.

But for all the above, it is also required that the government -from the Ministry of Labor in conjunction with the Ministry of Telecommunications- implement effective communication measures with companies that have the possibility of articulating tasks under the TT scheme, stimulated the implementation of it in conditions of equity and adequate and safe remuneration.

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