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REVIEW

Wireless networks and digital equity: a sustainable solution for internet access in rural areas, in Ipiales, Colombia

Redes inalámbricas y equidad digital: una solución sostenible para el acceso a internet en zonas rurales, en Ipiales, Colombia

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ABSTRACT

The Conectándote SAS BIC project emerged in 2018 as an entrepreneurial response to limited digital connectivity in rural areas of southern Colombia, specifically in the municipality of Ipiales and the former province of Obando. This initiative proposed providing internet services through long-range wireless networks, using WISP technology, with the aim of reducing the digital divide and improving the quality of life of vulnerable communities. Throughout the analysis, it became clear that although Colombia experienced sustained growth in internet use, this development was mainly concentrated in urban areas, leaving the rural sector behind. In line with this, international studies confirmed that the global expansion of connectivity has not been equitable. Limitations in coverage, speed and accessibility still significantly affect remote regions. The proposal by Conectándote SAS BIC stood out for its community-based, sustainable approach, adapted to the topography of the territory, prioritising technical solutions such as the use of radio links, solar energy and wireless control. In addition, it was based on current legal regulations and had a team committed to local development. This case demonstrated that it is feasible to promote digital inclusion processes through social entrepreneurship, generating positive impacts on education, access to information and social participation. The model proposed by this company constitutes a replicable alternative for other regions with similar geographical and social conditions.

Keywords: Digital Divide; Internet; Wireless Networks; Social Entrepreneurship; Connectivity.

RESUMEN

El proyecto Conectándote SAS BIC surgió en 2018 como una respuesta emprendedora a la limitada conectividad digital en zonas rurales del sur de Colombia, específicamente en el municipio de Ipiales y la ex provincia de Obando. Esta iniciativa propuso brindar servicios de internet mediante redes inalámbricas de largo alcance, utilizando tecnología WISP, con el objetivo de reducir la brecha digital y mejorar la calidad de vida de comunidades vulnerables. A lo largo del análisis, se evidenció que, aunque Colombia presentó un crecimiento sostenido en el uso de internet, este desarrollo se concentró principalmente en zonas urbanas, dejando rezagado al sector rural. En consonancia, estudios internacionales confirmaron que la expansión global de la conectividad no ha sido equitativa. Las limitaciones en cobertura, velocidad y accesibilidad aún afectan significativamente a regiones apartadas. La propuesta de Conectándote SAS BIC se destacó por su enfoque comunitario, sostenible y adaptado a la topografía del territorio, priorizando soluciones técnicas como el uso de radioenlaces, energía solar y control inalámbrico. Además, se fundamentó en normativas legales vigentes y contó con un equipo comprometido con el desarrollo local. Este caso demostró que es viable impulsar procesos de inclusión digital desde el emprendimiento social, generando impactos positivos en la educación, el acceso a la información y la participación social. El modelo planteado por esta empresa constituye una

alternativa replicable para otras regiones con similares condiciones geográficas y sociales.

Palabras clave: Brecha Digital; Internet; Redes Inalámbricas; Emprendimiento Social; Conectividad.

INTRODUCTION

Since the existence of humanity, man has sought to create new inventions to be recognized in society and improve his quality of life, and to do so, he uses the technological tools that exist in each era or generation. Thus, when communications, especially the internet and its protocols, appear, grand ambitions arise to cover the world using less time and resources. That is why everyday devices with greater technology are created and applied in the coverage of large territorial extensions and scopes about communications through the use of IPV, IPV4, IVP6, and VOIP protocols, among others.[1,2,3]

With the gradual increase in the use of mobile devices and the speed of time with which mankind lives, more demands are born, forcing society to seek new scalable solutions for connectivity in the network. This is why it creates high-range wireless networks where you do not have to make use of guided media but can develop the same functions by wireless means and devices.

With the emergence and application of this new technology, wireless internet service solutions can now be provided to most sectors, whether urban or rural, in various regions of the world and satisfy the needs of those who require them.

With the emergence of the WISP (Wireless Internet Service Provider), providers that offer wireless internet service via Wi-Fi or WiMAX, which basically consists of connecting to the Router or access point via Wi-Fi and using that connection through the links from the mother node with others to the destination, the tasks have become easier, and the number of customers worldwide has considerably increased.

However, nationally and internationally recognised companies do not reach these communities with the service due to various factors in different corners of the world that require this important service and are willing to pay a premium for it.

Given the above and to solve this problem and meet this need, the idea of entrepreneurship was born to create the company called Conectándote SAS BIC, which aims to bring this service to the communities of the Municipality of Ipiales and the former province of Obando, the rural sector with the best quality, legality and at a low cost to form an integral part with the communities and these with the company, not only to grow financially but also to be part of technological growth, intellectual and research in communities committed to the care and conservation of the environment.

Conectándote SAS BIC, with the commitment of its team, aims to cover 40 % of the population with business internet service, residential and through codes, in 2024 and continue to grow step by step with entrepreneurship, with a view to improving the quality of life through personal training for both business and community.

Conectándote SAS BIC, a social community project committed to the environment, seeks to bring internet service to the rural sector through renewable energy, such as solar panels and wireless control systems, especially for the correction of residential faults, under the rules governing the law 1901.

DEVELOPMENT

Market study

Background.

Project radio link vereda la argentina (la Tebaida - Quindío), degree project, Johan Mauricio López Giraldo, Daniel Arturo Rey Barbosa, Institution University Politécnico Gran Colombiano, Faculty of Engineering and Basic Sciences Specialisation in Telecommunications Project Management, 2017.[4]

Project objective. To generate a proposal to design and implement a radio link to meet the need for access to a data network in the village of La Argentina (La Tebaida - Quindío).

Conclusion. According to the content of this project in La Tebaida Quindío, the importance of telecommunications and the need to implement this type of project aimed at the rural sector can be seen. The deficiency of the State, the Ministry of ICT, and the companies that offer this service is not only in the municipality of Ipiales and the former province of Obando in the Department of Nariño but at the national level, since, as is well known, the State and multinational companies have little inclination to look at the rural sector.

Contextual framework

Macro location

The Department of Nariño, located in the extreme southwest of Colombia, is part of the Andean and Pacific regions. It is bordered to the north by Cauca, to the east by Putumayo, to the south by Ecuador, and the west

by the Pacific Ocean. Its capital is San Juan de Pasto. According to DANE data, it has a population of around 1,8 million inhabitants, distributed in 64 municipalities and five sub-regions. Most of its inhabitants belong to socio-economic strata 0, 1, and 2, and more than 50 % reside in rural areas. Forty-three percent reside in the municipal capitals, 57 percent in the rest of the department. According to activity status, the population is distributed as follows: 51 % 'economically active,' 20 % students, 24 % home occupations, 1 % retired and pensioners, and 4 % in another situation. Of the economically active population, 56 % work in the rural sector, 53 % are wage earners, and 32 % are self-employed. Nariño is the most populated department, with a diverse geography and a climate that varies according to altitude: hot in the Pacific plain and cold in the mountainous part, where most of the population lives.

This territory presents a complex and varied geography, which implies logistical challenges in implementing infrastructure, particularly in mountainous areas where a large part of the population lives. Employment conditions reflect a strong presence of rural labor and informality, contributing to structural barriers to access to technological services such as the Internet.

Theoretical framework

Internet access in Colombia continues to show marked territorial inequality. Although there has been a sustained growth in the number of users, this development is concentrated in urban areas, leaving rural communities behind.[1] This digital divide represents an obstacle to exercising rights such as education, work, and social participation.

From a theoretical perspective, Blaxter[5] argues that the contextual framework allows one to analyze the relationship between the physical and social environment and the phenomenon under investigation, facilitating the identification of real needs. In this sense, connectivity projects must consider local particularities in order to offer relevant and sustainable solutions.

Internationally, internet usage statistics show a global upward trend.[3] However, the VPNMentor[2] cybersecurity team warns that this expansion has not been equitable. Rural areas in developed and developing countries continue to face significant coverage, speed, and affordability limitations.

Faced with this problem, initiatives such as Conectándote SAS BIC have become viable strategies for bridging the digital divide. Its business model, based on the provision of the Internet through long-range wireless networks (radio links) using local topography, represents a solution adapted to complex geographical contexts.

The enactment of the Internet Law as an essential and universal service in Colombia[6] has generated a new regulatory framework that obliges the state and service providers to guarantee coverage even in traditionally excluded areas. Despite these advances, reports from the Ministry of Information and Communication Technologies[7] show that coverage in rural areas is still insufficient, which validates the relevance of community connectivity projects such as this one.

Previous experiences, such as the proposed radio link in the village of La Argentina in Quindío,[4] have shown that it is possible to improve internet access in remote regions through adapted technical solutions. In turn, studies such as Miguel's[8] reveal that lack of connectivity negatively impacts essential aspects such as education, especially during crises such as the COVID-19 pandemic.[6]

Project context

Conectándote SAS BIC emerged in 2018 as a telecommunications company with a social focus. It is oriented towards the provision of internet services in rural areas using wireless technology. Its operation as a Wireless Internet Service Provider (WISP) allows it to offer connectivity using radio links supported by hills and elevated structures without affecting the natural environment.

The project responds to the need for network access in sectors with low coverage, prioritising vulnerable communities in the municipality of Ipiales and the former province of Obando. Its operation is governed by environmental and technical regulations, seeking operational sustainability and social responsibility.

Micro location

Conectándote SAS BIC was created to provide internet service in its different modalities to the communities of the municipality of Ipiales Nariño and the former province of Obando, its villages and hamlets that can reach the coverage, especially to families in the rural sector strata 0, 1 and 2.

The company focuses its operations in the municipality of Ipiales, the department of Nariño, from where it coordinates the service provision to different villages and hamlets. It has a central office, technical laboratories, and five payment points distributed in strategic areas such as Chacua, Yaramal, Mueses, Cárdenas, and Las Cruces. In addition, it facilitates the customer service process through direct communication lines via instant messaging.

The project is distinguished by its personalized attention, responsiveness, and community focus. The work team comprises professionals committed to organizational development and respect for the environment, reinforcing its social vocation and positioning it as a replicable model in other territories with similar conditions.

CONCLUSIONS

Internet access has been consolidated as a fundamental right and a basic need for the integral development of communities. However, in Colombia, the coverage of this service continues to be profoundly unequal, mainly affecting rural areas such as those in the department of Nariño. The persistence of these digital divides limits equitable access to educational, employment, and social opportunities, deepening the conditions of vulnerability in the country's most remote regions.

In this context, the emergence of initiatives such as Conectándote SAS BIC represents a concrete, innovative, and socially responsible response to the lack of coverage by large operators. By implementing technological solutions based on long-range wireless networks adapted to the geographical and socioeconomic conditions of the territory, this project not only facilitates access to the internet but also strengthens digital inclusion, promotes local development, and fosters environmental sustainability through renewable energies.

The experience of Conectándote SAS BIC shows that it is possible to bridge the digital divide through social entrepreneurship, technical knowledge, and commitment to communities. This model can serve as a reference for other regions with similar difficulties, showing that rural connectivity is a challenge and an opportunity to transform realities, promote innovation, and build a more equitable and connected country.

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FINANCING

None.

CONFLICT OF INTEREST

None.

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