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INTERNET FOR ALL AND TECHNOLOGICAL DEVELOPMENT

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Abstract
The Internet is a network that connects millions of devices through communication protocols to transmit and receive information from Earth, the Moon, other planets, artificial and natural satellites, etc. Information is sent and received in pulses of light or electricity, which are processed by the communication system. 5G and 6G are the fifth and sixth technological generations of telephony; phones are, among other devices, computers that receive and transmit information. Space, fiber optics, and metallic cables are the most common transmission media that allow information to travel from one point to another over long and short distances.

Thirty-seven percent of the world’s population, approximately 2.9 billion people, have never used the Internet. The International Telecommunication Union (ITU), a United Nations agency for information and communication technologies (ICT), reports an increase in Internet usage due to the pandemic, from 4.1 billion users in 2019 to 4.9 billion in 2021.

Providing Internet access in rural, poor, and remote communities is not only a democratic right for their inhabitants but also an intrinsic necessity for society in those areas of the world. Internet access enables services such as mobile housing for mountain tourism, remote work for employees of various companies in even the most inaccessible locations, and the establishment of businesses in remote rural communities, among others. This could encourage some urban populations to migrate to rural areas.

Technological development reduces political, social, and economic conflicts. Therefore, if there is no full Internet coverage in a country, region, or continent, technological development will remain accessible only to certain sectors of the population in technologically advanced countries, while the situation will be even worse for countries without such development. As a result, social conflicts will continue to grow. For this reason, public policies should be directed toward achieving full Internet coverage, with support from international organizations such as the International Telecommunication Union.

Technological development can be achieved by integrating basic and applied scientific research into companies based on their objectives, goals, and market strategies. This not only leads to the creation of new products, goods, and services but also provides employment opportunities for technicians and researchers from educational institutions.

Introduction
The transmission and reception of information through the internet has evolved very rapidly up to the present moment, in which we find ourselves in the era known as Artificial Intelligence (Revista de Robots, 2023). This has allowed society to enjoy greater benefits, as people have developed skills for everyday life and work thanks to the internet. However, internet access is not uniform across rural communities worldwide, even though it is a high-priority service with many advantages for all of society. In fact, instead of narrowing the digital divide, it has increased between rural and urban areas (Romero García, 2023).

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Therefore, the purpose of this topic is to analyze the importance of internet access and its relationship with technological development in rural and urban communities. The results indicate that access to the internet in urban areas has led to higher economic income, which is associated with greater political, economic, and social benefits. In contrast, both rural and urban areas that do not use the internet experienced lower economic income (Jiménez García, 2021). It is thus concluded that there is a digital divide between urban and rural areas, and that internet access in society promotes an increase in people's standard of living.

If it is believed that providing internet to rural communities is less important than offering this service to urban communities, a serious mistake is being made. This is because city dwellers seek places with lower costs where they can work online; companies are migrating to rural communities, such as car assembly plants; and there are mobile homes placed in the hills for tourism or other activities. Therefore, a country without full coverage will experience more or fewer deficiencies depending on the size of the digital divide. In other words, for the good of all, rural regions must be prioritized first.

Satellites are essential for long-distance communication since there are no obstacles for transmitting and receiving information. The satellite system is useful for accessing the internet in both urban zones and regions where there is no terrestrial coverage due to the unattractiveness of investment for telecommunications companies in remote areas with difficult access and low population (González Bonilla, 2020).

To operate, a satellite must be assigned an orbit by the International Telecommunication Union (ITU), which is a very scarce resource. This situation has generated a global search for orbital positions that operate more efficiently for the technological development of the satellite industry. Therefore, international, regional, and national regulations must be under constant review in order to address related issues during the ITU's World Radiocommunication Conferences.

Satellite orbits are occupied by countless satellites. Countries or companies interested in acquiring an orbit must register and enter a waiting list for orbits and their corresponding frequencies to become available. Companies or countries that, due to various circumstances—especially a lack of economic resources—are unable to replace satellites that have reached the end of their useful life or that have malfunctions, may have their licenses revoked by the ITU.

Satellites are located in their corresponding orbits at three main altitudes: GEO satellites are located 37,000 km above the equator, forming a circular orbit. They are synchronized with the Earth's rotation axis, allowing them to focus on a specific region; with three such satellites, the entire globe can be covered. MEO satellites are positioned between 10,000 and 20,000 km, and LEO satellites are around 5,000 km.

The ITU, which is part of the United Nations (UN), is responsible for managing the orbit-spectrum resource (ESA, 2025). For this purpose, the ITU has a Radio Regulations (RR) document that establishes coordination procedures and mechanisms allowing countries to access this resource. These consist of three stages: 1) advance publication, 2) coordination, and 3) notification/registration.

In the advance publication stage, interested parties send the orbital occupation project to the ITU Radiocommunication Bureau, where it is analyzed and published in a circular, including a list of potentially affected users. In the coordination stage, interested parties submit more detailed information about the project to the Radiocommunication Bureau, and this is also published for public knowledge.

During this stage, stakeholders aim to coordinate with administrations that have declared themselves affected. Interested parties must have a real project, as technical negotiations are required at a very precise level. Once coordination is complete—that is, agreements have been reached with potentially affected parties—in the notification/registration stage, the satellite network notification is submitted to the Radiocommunication Bureau for analysis and publication. If accepted, the satellite network is entered into the International Frequency Register (Lewis, 2025).

Mexico has four geostationary orbits assigned by the ITU. At the same time, the country has granted most of them in concession to private companies. Three satellites are operated by the French company Eutelsat

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in the 113°W, 115°W, and 117°W orbits. The company Quetzsat holds the concession for Quetzsat 1 in the 77°W orbit. Mexsat, a state-owned company, manages three other satellites: Bicentenario at 114.9°W, Centenario at 113°W, and Morelos III at 113.1°W (D.O.F., 2023).

Below is a proposed process aimed at achieving satellite technological development in Mexico, which is essential, among many other benefits, for achieving internet coverage throughout the entire national territory to produce goods and services that will result in the country's technological development.

Satellite Technological Development

Methodology

An analysis will be conducted of several planning models, among them those of Ackoff (1986), Steiner (1969), Ozbeckhan (1974), and Sainz de Vicuña Ancín (2016). It is concluded that any planning model can be designed in five phases, which are listed below:

1. Information analysis.
2. Problem identification.
3. Planning to solve problems and to project the organization.
4. Results.
5. Evaluation.

The planning model stages proposed by these authors are described below and can be represented within the five phases mentioned.

The planning model proposed by Russell L. (2012) consists of five stages. The first, called "ends," includes the following phases: (1) system information analysis and (2) problem detection, which allows for understanding the current state of the system. In the second and third stages—"means" and "resources"—phase 3 is implied: planning to solve problems and to project the organization. The fourth stage, "implementation," corresponds to phase 4, results. Finally, the fifth stage, "control," includes phase 5, evaluation.

Similarly, the planning model by Steiner (1969) is analyzed: the expectations of internal and external stakeholders, the first stage, imply phases 1 (system information analysis) and 2 (problem detection). The following stages—strategies, programming, and plan implementation—make up phase 3, planning. Lastly, the review and evaluation stage encompasses phase 4, results, and phase 5, evaluation.

The model by Ozbekhan (1973) begins with the stages of problem detection, trends, and logical future, which correspond to phases 1 (information analysis) and 2 (system diagnosis). The subsequent stages align with phase 3, planning (normative, strategic, and organizational). The normative stage refers to objectives, mission, and values; strategic planning sets the strategies to achieve the objectives; and organizational planning involves the rational use of available resources to accomplish the proposed goals. Finally, there is the evaluation stage, which includes phase 4 (results) and phase 5 (evaluation).

Sainz de Vicuña Ancín (2016) considers only three stages, as he does not include the results and evaluation stages. The first stage consists of the analysis of the external and internal situation and diagnosis, corresponding to phases 1 and 2. To perform the diagnosis, Sainz suggests using tools such as SWOT or the competitive positioning matrix; however, he notes that if the latter is used, it must always be supported by the former.

The second stage refers to strategic decisions, and the third stage to operational decisions. These last two stages correspond to phase 3, planning. The stages corresponding to results and evaluation are valid only when there is a direct possibility of system transformation; otherwise, the planning models conclude with the proposal and the feasibility of execution.

Based on these considerations, the Systemic Model (SM) for the Development of Space Communications (DSC) is designed.

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The SM is presented in three stages based on Wiener's model: the first stage, or input (E), consists of phase 1, which is further divided into sub-phases 1 and 2. The second stage, or box (C), consists of phases 2, 3, and 4, which are divided into sub-phases 3, 4, 5, 6, and 7. The third stage, or output (S), consists of phase 5, which in this case is also sub-phase 8.

The first stage, or input (E), refers to the context and foundation of the research—in other words, what has been done, what the current situation is, and what remains to be done regarding the DSC. The second stage, box (C), is what enables the achievement of the third stage, output (S), that is, technological development (TD), starting from the first stage.

The first phase—information analysis of the SM for the DSC—is proposed with two sub-phases: sub-phase 1, analysis of the international satellite system; and sub-phase 2, analysis of the Mexican satellite system. The second phase consists of sub-phase 3, which corresponds to the diagnosis. The third phase includes sub-phase 4, a proposal to solve the issues of the Mexican Satellite System (MSS). The fourth phase, planning to solve the problems and project the organization, includes three sub-phases: 5 (mission, vision, and values of the proposal), 6 (strategy), and 7 (strategic plan). The fifth phase, corresponding to results and evaluation, consists of sub-phase 8, which proposes technological development for the DSC.

Table 1

Phases of the Systemic Model	**Sub-phases of the SM for Space Communications Development (SCD)**
I. Information Analysis	1. Analysis of the International Space System 2. Analysis of the Mexican Space System
II. Problem Detection	3. Diagnosis of the Mexican Space System
III. Proposal for Solution	4. Solution Proposal for the SCD
IV. Planning to Solve the Problem and Project the System Toward the Corresponding Objective	5. Mission, Vision, and Values for the SCD 6. Strategies for the SCD 7. Action Plan for the SCD
V. Evaluation and Results	8. Evaluation and Results of the SCD

The design of the SM for the SCD must be placed within the global planning process and schematically present the phases for its development. The systemic plan must have long-term validity and be continuously renewed, indefinitely (Sainz de Vicuña Ancín, 2016).

Sub-phase 1: Analysis of the International Satellite System

The analysis of the international satellite system's situation must enable the MSS (Mexican Satellite System) to define key success factors for national technological development, considering those external factors beyond its control.

Among other relevant considerations are: policies of developed countries in space matters and how they have achieved major technological advancement in the satellite industry; the global distribution of satellite orbits, including the difficulties or opportunities to obtain them; international organizations that regulate, promote, and support telecommunications development; the issues of pollution, environmental degradation, and risks to life caused by space debris; and the importance of generating economic

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resources to assess the convenience of national involvement in satellite technological development (Comisión Nacional de Mejora Regulatoria, 2020).

Sub-phase 2: Analysis of the National Satellite System

This section aims to evaluate the MSS in order to determine whether the Mexican State has implemented appropriate strategies and whether the execution of those decisions has been effective—whether things are being done properly.

It analyzes the policies implemented by the Mexican State for the development of the MSS; the regulatory framework within which it operates; the importation of satellite technology; the performance of companies with orbit concessions assigned by the ITU (D.O.F., 2023); unused orbital slots; scientific research, both basic and applied, generated by public and private institutions; the organizations created by the State to promote space development; the human resources trained by academic institutions; and proposed projects for satellite development, as well as the emergence of academic organizations with similar goals, among other factors.

It is necessary to evaluate the strategy followed by the Mexican State to review the results and determine whether the implemented policies have, overall, been successful or not.

Sub-phase 3: Diagnosis

The diagnosis is always the result of prior analysis and the synthesis of internal and external system factors, from which conclusions can be drawn and a concrete strategy formulated. For diagnosing the MSS, the SWOT tool will be used.

One of the most commonly used tools for diagnosis is SWOT (Strengths, Weaknesses, Opportunities, Threats). Another is the competitive positioning matrix, which reflects the market position using two variables: market viability and product comparison against competitors. If this matrix is used, it is always advisable to reinforce it with SWOT, especially when diagnosing for a strategic plan (Sainz de Vicuña Ancín, 2016).

Sub-phase 4: Proposal

After describing what has been done and what remains to be done with regard to the MSS, it is now possible to propose its transformation. In this sub-phase, it is important to ensure the proposal is feasible and implementable. This is not about improving the existing system, but rather about changing the entire current approach through a new strategy that enables technological development (TD) of the MSS. Therefore, the proposal is as follows:

The Mexican State, as a regulator of the economy and driver of national policy aligned with international policy, can establish a policy to integrate scientific research into companies; and promote public and private investment to create self-sustaining satellite companies that generate wealth. These can be public, mixed, or private, and should systematically integrate basic and applied scientific research to enable space TD. The objective is to provide fast, efficient, safe, and affordable services that meet the needs of national and international users.

Sub-phase 5: Mission, Vision, Values, and Objectives of the Proposal

The concepts of mission, vision, values, and objectives (Donoso & Burt, 2013) guide the direction and goals of the proposal presented in sub-phase 2.4.

The **mission** is the reason for the MSS's existence—its goal or purpose to contribute to national development in economic, social, political, ecological, and other areas. It defines what is to be fulfilled and for whom, through companies using available resources and diverse capacities.

The **vision** is the long-term path for the MSS, serving as a guide and motivation to orient strategic decisions toward growth and competitiveness. Achieving this requires the systematic integration of scientific research into companies (Beyhan & Cetindamar, 2011). Clear goals must be set to increase productivity and competitiveness in the market, and therefore, strategies must be formulated to lead the organization toward the desired goal.

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Values are the ethical principles of our culture that reflect who we are and what we believe in, and they allow us to establish our behavioral guidelines. The development of the MSS must be guided by responsibility toward the environment and social causes.

Strategic or Global Objectives

Strategic or global objectives are long-term goals. They represent the expected outcomes of the decisions made by the Mexican State to achieve the mission and vision aimed at developing the MSS (Sainz de Vicuña Ancín, 2016).

Sub-phase 6: Strategies

In a systemic approach, strategies are a means to achieve long-term objectives—typically within a three-to-five-year span—and they often lead to the transformation of the system. In contrast, if the approach is one of continuous improvement, strategies may be short-term, meaning less than two years (Van Gigch, 2012).

The strategies must consider the development goals and objectives of the MSS, taking into account both the internal and external situation. To design the strategies for the MSS, we will use matrices derived from the SWOT analysis: the External Factor Evaluation Matrix (EFE) and the Internal Factor Evaluation Matrix (IFE). These will help identify the strengths of the MSS, leverage opportunities presented by the international communications community, and consider our weaknesses relative to external threats (Fred R., 2013).

Sub-phase 7: Strategic Plan

In this sub-phase, the design of the strategic plan is proposed. It must be consistent with everything previously stated in the earlier phases. The strategic plan for the MSS outlines how technological management should be carried out. That is, it proposes to the Mexican State the implementation of decisions regarding policies, plans, programs, projects, etc., related to the creation, dissemination, transfer, and use of technology.

The strategic plan is like a puzzle in which the pieces must fit together across the different stages of the plan, consolidating and shaping the vision until it materializes into a well-defined project, with the ultimate goal of achieving technological development (Sainz de Vicuña Ancín, 2016).

Sub-phase 8: Technological Development

This is the final sub-phase that completes our Systemic Planning Model (SPM) for the MSS. At the end of the cycle, we can readjust each of the five phases—comprising eight sub-phases—as needed, either to achieve better results or to make new considerations based on the system's evolution.

The technological development of the space industry is essential to everyday life, as it enables voice, data, and video services anywhere on the planet—and even beyond. Technological development is a concept that generates wealth and implies social, political, and economic progress within an ecological context, ensuring equitable distribution of wealth for the well-being of the population.

Figure 1.

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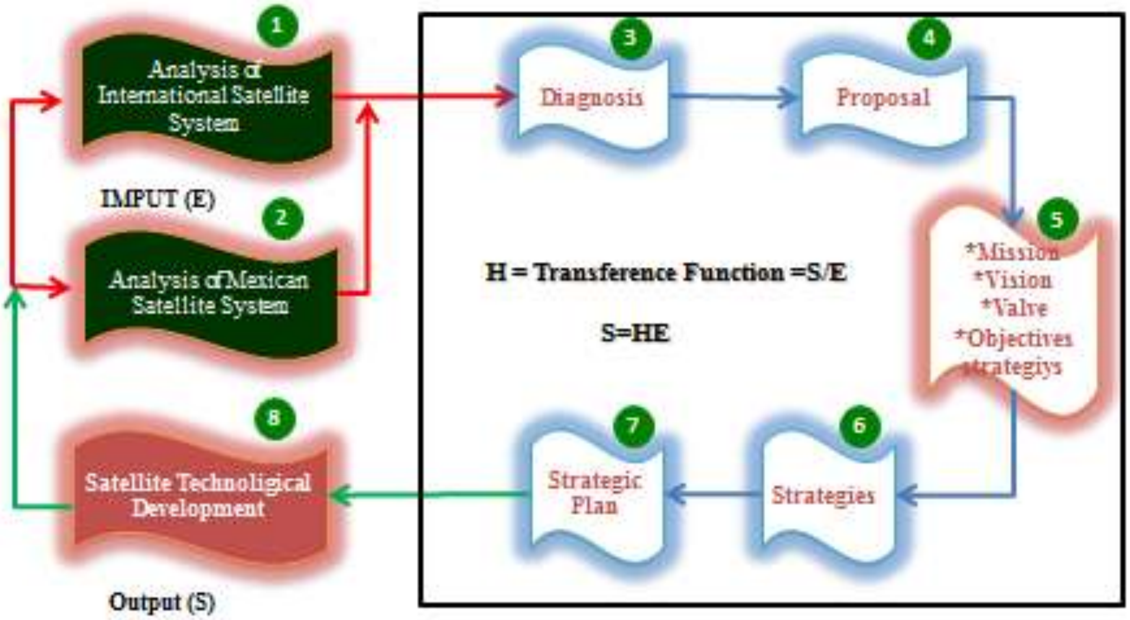

Figure 1: Systemic Model for the Development of Space Communications

Note: The Systemic Model for the Development of Space Communications is presented.

Validation of the SM for the DCE

If the input E and output S are fixed, then the black box C has an infinite number of solutions, as long as the output S is the expected response, which, in our case, is technological development.

Based on the actual functioning of an electrical system, where C has infinite solutions based on the first-order Wiener model and Shannon's Mathematical Theory of Information, which involves the feedback or self-regulation of the system.

If the box has infinite solutions, then a planning model is neither better nor worse than others; simply, a model is valid if it achieves the expected results. Therefore, $S = C*E$, i.e., S is directly proportional to C and E. Hence, $C = S/E$. If S and E have the maximum value, for example, on a scale of 10, then $C = 1$; therefore, C will always be 1 in an ideal case, and in a real case, it will be less than 1, as the expected results are generally partially satisfactory.

Results

Emerging countries lack technological development, especially in the space field. Some of these nations have geostationary orbits with their corresponding frequencies assigned by the International Telecommunication Union (ITU) so that they can launch their satellites. However, due to the lack of technological development, these countries pay for the design, construction, and launch of their satellites in industrialized nations, leading to enormous monetary costs.

A geostationary satellite has a useful life of approximately 15 years. Due to the high costs of launching a satellite into orbit, emerging countries cannot cover these expenses, as they also have to replace satellites once their useful life ends, or in cases of construction failures, rocket explosions, or collisions with space debris, which endangers the loss of orbital concessions with their corresponding frequencies.

To achieve technological development, particularly in space, a state policy is required that integrates basic and applied scientific research in companies based on their objectives, goals, and market strategies, as developed countries do.

With the upcoming foundation of the Latin American and Caribbean Space Agency (ALCE) in September 2021, there is an opportunity for our underdeveloped countries to generate technological development,

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particularly in space (Forbes, 2021). This ALCE project should include the construction and launch of low Earth orbit (LEO) satellites, which are located about 5,000 km or less, as it reduces transmission and reception times due to the lower altitude compared to medium Earth orbit (MEO) satellites, which are between 10,000 and 20,000 km, and high Earth orbit (GEO) satellites, which are at an altitude of 37,000 km.

The transmission and reception time of LEO satellites is about 20 milliseconds, which is essential for the 6th generation of mobile phones known as 6G. This generation aims to reduce transmission and reception times, while GEO satellites have a delay time of approximately 500 milliseconds.

Therefore, to achieve total coverage, the first step is to build satellite infrastructure to cover the national territories with the internet network, thus fostering the technological development necessary for the welfare of our people.

Conclusions

Based on the description in this document, it is concluded that satellite technological development is essential to provide internet services across the national territory. These services are necessary for local inhabitants, visitors, and businesses who temporarily or permanently arrive in rural areas. If these needs are not addressed, wealth distribution will not be equitable, leading to political, economic, and social conflicts that are constantly generated.

Technological development is feasible in countries that currently lack it, as long as they have the necessary resources, as is the case in Mexico, including higher education institutions, research centers, technicians, professionals, and researchers. Achieving this requires that the Mexican State implement an effective and efficient reform that integrates basic and applied scientific research in companies based on their objectives, goals, and market strategies.

For space communications development, developing countries are constructing small satellites, generally at an academic level. However, construction should depend on the operational frequencies, which are assigned by the International Telecommunication Union, the required characteristics, the launch bases, and operation within the national and international regulatory framework.

On September 18, 2021, Mexico, along with Argentina, Bolivia, Costa Rica, Ecuador, and Paraguay, founded the Latin American and Caribbean Space Agency (ALCE, 2021). This is an opportunity for Latin American and Caribbean countries to achieve space technological development and thus cover internet networks, overcoming the current situation where these countries lack launch bases and have to send their satellites to developed nations for launch, which is extremely costly.

In summary, for a country to achieve technological development, its territory must be covered by an internet network. Without this coverage, its technological development will be partial, leading to increased political, economic, and social conflicts.

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