



REFLECTIONS AND PATHWAYS TOWARD ENSURING MEANINGFUL CONNECTIVITY IN THE AMAZON

INTERNETLAB

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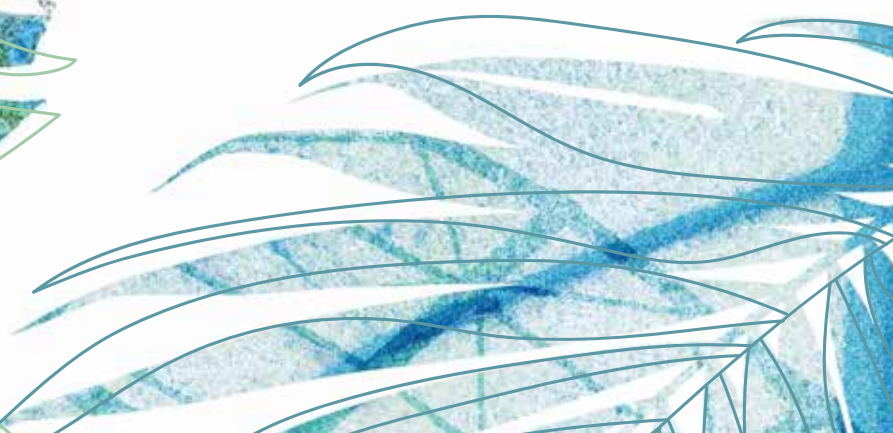
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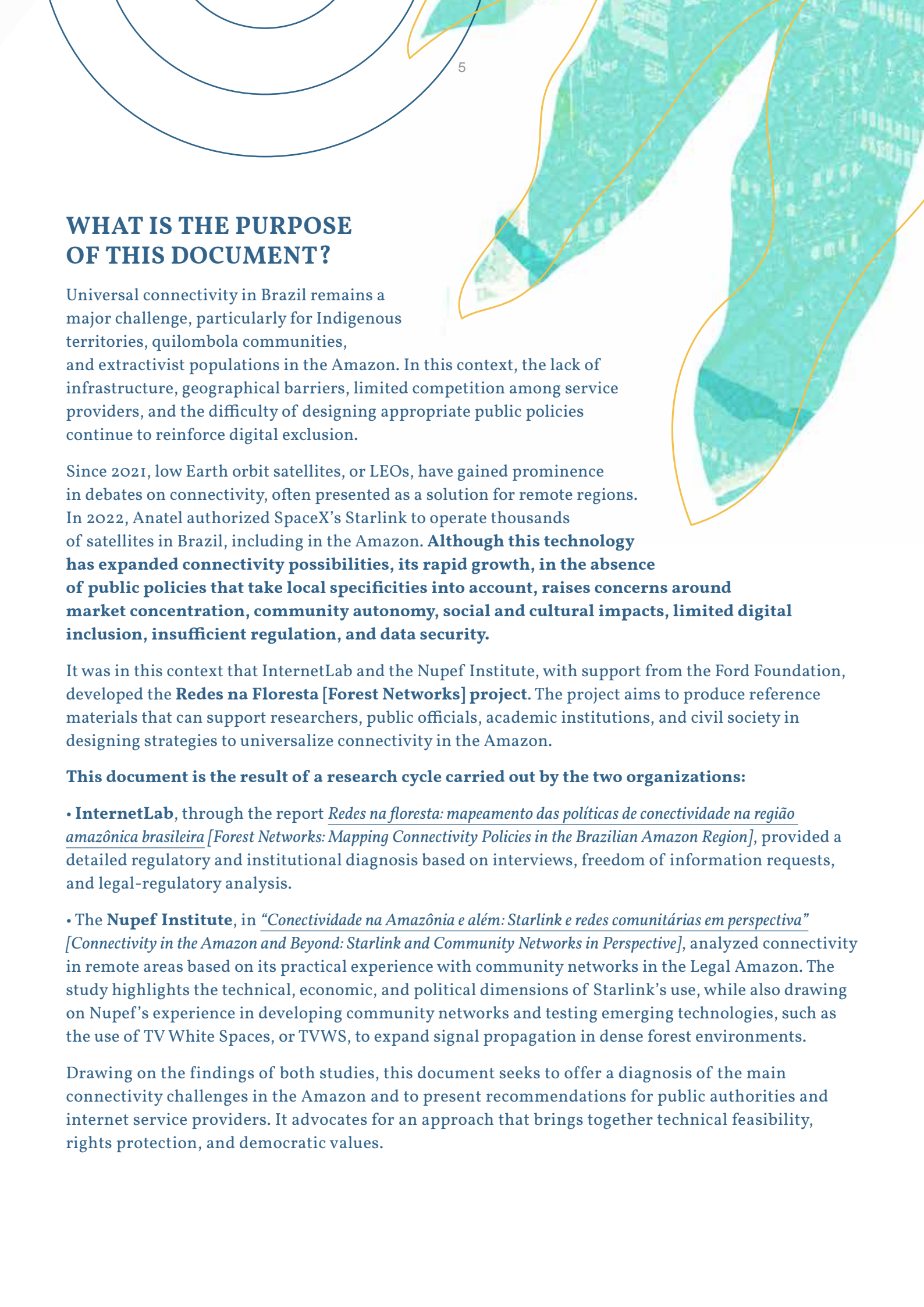
ABOUT THE ORGANIZATIONS

InternetLab is an independent, interdisciplinary research center that produces knowledge and promotes public debate across different areas involving technology, rights, and public policy. We are a nonprofit organization based in São Paulo, working as a bridge between researchers and representatives from the public sector, the private sector, and civil society. Our work is grounded in the understanding that sound public policymaking depends on more accurate diagnoses of the relationship between new information and communication technologies — such as the internet — and people's rights.

Learn more: internetlab.org.br

The Nupef Institute is a Brazilian civil society organization that, since 2005, has been dedicated to producing and sharing knowledge on the effective and secure use of Information and Communication Technologies, or ICTs. We work to promote human rights and socio-environmental justice through the safe use of ICTs, focusing on two main programmatic areas: the Right to Connectivity and Territorial Protection, and Resilient Infrastructure and Information Security. We bring together traditional knowledge and specialized expertise to strengthen the ability of civil society organizations, social movements, and socially vulnerable communities to appropriate these technologies. Working at the intersection of technology and territory, Nupef contributes to community resilience and to the advancement of socio-environmental justice.

Learn more: nupef.org.br



WHAT IS THE PURPOSE OF THIS DOCUMENT?

Universal connectivity in Brazil remains a major challenge, particularly for Indigenous territories, quilombola communities, and extractivist populations in the Amazon. In this context, the lack of infrastructure, geographical barriers, limited competition among service providers, and the difficulty of designing appropriate public policies continue to reinforce digital exclusion.

Since 2021, low Earth orbit satellites, or LEOs, have gained prominence in debates on connectivity, often presented as a solution for remote regions. In 2022, Anatel authorized SpaceX's Starlink to operate thousands of satellites in Brazil, including in the Amazon. **Although this technology has expanded connectivity possibilities, its rapid growth, in the absence of public policies that take local specificities into account, raises concerns around market concentration, community autonomy, social and cultural impacts, limited digital inclusion, insufficient regulation, and data security.**

It was in this context that InternetLab and the Nupef Institute, with support from the Ford Foundation, developed the **Redes na Floresta [Forest Networks] project**. The project aims to produce reference materials that can support researchers, public officials, academic institutions, and civil society in designing strategies to universalize connectivity in the Amazon.

This document is the result of a research cycle carried out by the two organizations:

- **InternetLab**, through the report *Redes na floresta: mapeamento das políticas de conectividade na região amazônica brasileira [Forest Networks: Mapping Connectivity Policies in the Brazilian Amazon Region]*, provided a detailed regulatory and institutional diagnosis based on interviews, freedom of information requests, and legal-regulatory analysis.
- The **Nupef Institute**, in *“Conectividade na Amazônia e além: Starlink e redes comunitárias em perspectiva” [Connectivity in the Amazon and Beyond: Starlink and Community Networks in Perspective]*, analyzed connectivity in remote areas based on its practical experience with community networks in the Legal Amazon. The study highlights the technical, economic, and political dimensions of Starlink's use, while also drawing on Nupef's experience in developing community networks and testing emerging technologies, such as the use of TV White Spaces, or TVWS, to expand signal propagation in dense forest environments.

Drawing on the findings of both studies, this document seeks to offer a diagnosis of the main connectivity challenges in the Amazon and to present recommendations for public authorities and internet service providers. It advocates for an approach that brings together technical feasibility, rights protection, and democratic values.

CONTEXTS AND DIAGNOSES

The following section presents the main diagnoses and contextual findings produced through the joint work of InternetLab and the Nupef Institute under the Forest Networks Project. These findings not only reveal the persistence of structural barriers to universal connectivity in the Amazon, shaped by regulatory, geographical, and political factors, but also examine the effects of incorporating emerging technological solutions, especially low Earth orbit satellites, on the ways of life, conditions of autonomy, and rights of Indigenous, quilombola, and extractivist populations.

Rather than offering a merely descriptive account, this section seeks to provide an evidence base for critically understanding both the challenges and the potential of connectivity in the region. Its purpose is to support the development of policies, strategies, and practices capable of bringing together technological innovation, rights protection, and respect for the sociocultural specificities of the communities involved.

CONNECTIVITY IN THE LEGAL AMAZON IS DEEPLY UNEQUAL, BOTH IN TERMS OF INFRASTRUCTURE AND QUALITY OF ACCESS

We start from the premise that **internet access alone is not enough to overcome digital exclusion. Public policies must be designed to ensure meaningful connectivity**¹ for communities in the Legal Amazon² — that is, connectivity understood through a broader set of access and use conditions, beyond the availability of a connection.

In seeking to measure meaningful connectivity³ in Brazil, a study by NIC.br identified three main trends: (i) the number of users with meaningful connectivity is considerably lower than the number of people with internet access; (ii) access to quality connectivity is shaped by gender and territorial inequalities, with men and residents of urban areas showing higher levels of meaningful connectivity; and (iii) individuals with meaningful connectivity are more likely to access essential services online.

These access inequalities were also highlighted in the 2023 ICT Households Survey, which points to an overlap of vulnerabilities in the country's most disadvantaged regions. In this context, the North region stands out as one of the most challenging areas in terms of meaningful connectivity: only 11% of the population reaches the highest levels of the scale, while 44% falls into the group with the poorest access conditions.

The *TIC Domicílios*⁴ [ICT Households Survey] shows that 84% of Brazilian households have some form of internet access. However, while the South and Southeast regions have 89% and 85% of households connected, respectively, these rates fall to 80% in the Northeast and 78% in the North.⁵ One of the reasons for the lack of internet access is the cost of the connection. In the Northeast and North — the regions with the lowest per capita income in the country — 27% and 35% of respondents, respectively, state that “the price is too high.” In the South and Southeast, the corresponding shares are 15% and 24%. Internet access is also most expensive in the North: 37% of households pay between BRL 101 and BRL 150, while 5% pay more than BRL 150.

¹ ITU. *Measuring digital development – ICT Development Index 2024*. Available at: https://www.itu.int/hub/publication/d-ind-ict_mdd-2024-3/. Accessed on: March 1, 2024.

² The Legal Amazon comprises the states of Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima, and Tocantins, as well as part of the state of Maranhão.

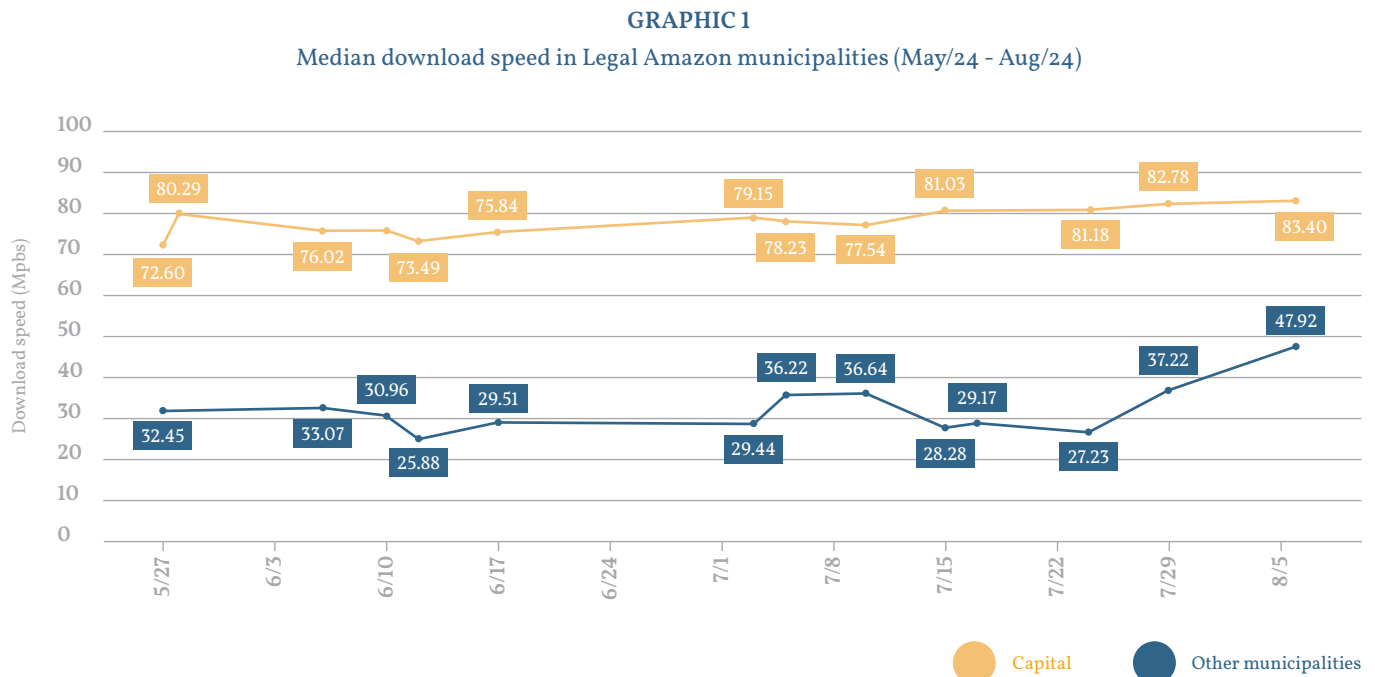
³ The NIC.br report uses the concept of “meaningful connectivity” developed by the Alliance for Affordable Internet (A4AI, <https://adi.a4ai.org/meaningful-connectivity/>). According to this source, meaningful connectivity “is a tool for understanding and increasing the level of internet access and setting more ambitious policy targets for digital development.” It is based on four minimum thresholds across four dimensions of internet access: “1) regular internet use, with daily use as the minimum; 2) an appropriate device, with access to a smartphone as the minimum; 3) sufficient data, with a broadband connection at home, work, or place of study as the minimum; and 4) a fast connection, with 4G mobile connectivity as the minimum.”

⁴ The TIC Domicílios [ICT Households Survey], conducted by the Regional Center for Studies on the Development of the Information Society (Cetic.br), part of the Brazilian Network Information Center (NIC.br), has produced statistical data on the presence of Information and Communication Technologies (ICTs) in Brazilian households, as well as on access to, use of, and skills related to these technologies among people aged 10 and older. For the latest edition, see: CGI.br. *Survey on the Use of Information and Communication Technologies in Brazilian Households: ICT Households 2023*. Available at: <https://cetic.br/pt/pesquisa/domicilios/>. Accessed on: March 5, 2024.

⁵ Composed of the states of Acre, Amapá, Amazonas, Pará, Rondônia, Roraima, and Tocantins.

Inequality becomes even more pronounced when connection speed is taken into account: 39% of households in the South and 32% in the Southeast have speeds equal to or above 51 Mbps, compared to only 18% in the Northeast and 24% in the North. In addition, the North has the highest share of people who do not know their connection speed, at 21%.⁶

The chart below presents median download speeds in municipalities across the Legal Amazon, highlighting a significant gap between state capitals and other municipalities: while the capitals have a median speed of 83.4 Mbps, the other municipalities analyzed do not exceed 47.92 Mbps.



Source: Relatório Redes na Floresta (InternetLab, 2025).

There are also significant disparities in the distribution of telecommunications networks that support internet connectivity. According to Anatel's Structural Plan for Telecommunications Networks (PERT), published in July 2025, 78.3% of Brazilian municipalities were served by fiber-optic backhaul — the high-capacity transport network that is essential for providing quality internet access. A total of 1,207 Brazilian municipalities still depended on lower-quality solutions or lacked adequate network infrastructure altogether. The absence of this infrastructure primarily affects localities in the North and Northeast regions, as well as parts of northern Minas Gerais.

As Idec points out⁷, inhospitable distances and limited economic attractiveness for the private sector reduce the availability of services. In many localities, there is no prospect of internet access at all; where access does exist, it is unstable, slow, and expensive, making it impossible to fully use the internet as a means of exercising rights and communicating.

⁶ The data help shed light on the broader context. However, it is important to note that most surveys collect data in areas that meet minimum population and population-density thresholds. As a result, communities located far from municipal seats and urban centers, especially those with fewer than 300 people, tend to remain invisible in these datasets. Inequalities are therefore likely to be even deeper than the available data suggest.

⁷ IDEC. Internet Access in Brazil's North Region. 2022, p. 3. Available at: https://idec.org.br/arquivos/pesquisas-acesso-internet/idec_pesquisa-acesso-internet_acesso-internet-regiao-norte.pdf. Accessed on: March 26, 2024.

Precarious internet access in the Legal Amazon stems from a combination of structural factors that bring together economic, territorial, and infrastructural inequalities. Limited coverage, poor signal quality, high connection costs, restricted access to devices, and insufficient energy supply create a scenario that undermines the universalization of connectivity.

This connectivity landscape in the Amazon sheds light on the structural gaps that help explain the growing relevance of low Earth orbit satellites as a viable alternative in the region. The arrival of providers such as Starlink — SpaceX’s satellite internet system — with low Earth orbit satellites promising lower-cost internet access and easier deployment, created expectations that this alternative could change Brazil’s connectivity landscape.

In this vacuum of effective implementation, space opened up for market-based solutions detached from any national public policy. For analysts such as Steve Song, Starlink’s entry into the Amazon represented an emblematic case of so-called “digital colonialism” (SONG, 2024⁸). This scenario is not unique to Starlink. Other big tech companies, such as Amazon through Project Kuiper, have already shown interest in occupying Brazil’s digital space, supported by high-level negotiations, including meetings involving former CIA directors on cybersecurity and promises of multibillion-dollar investments in infrastructure. The threat, therefore, lies in the continuation of a dependency model in which control over data and infrastructure remains in external hands.

The Amazon, historically a target of exploitation, is now experiencing an updated version of this process. The mass collection of cultural, environmental, and personal data turns individuals and communities into sources of information for the global market, without mechanisms for protection or fair compensation. Successive national policies aimed at universalizing broadband access, although well developed from a regulatory standpoint, have not translated into effective action. The gap left by non-implementation has allowed foreign companies to occupy this space according to their own interests, reproducing practices of exploitation and dependency that reinforce digital colonialism over the Amazon and its populations.

This scenario shows that overcoming digital inequalities in the Amazon region requires a paradigm shift. Rather than approaching connectivity merely as a matter of infrastructure, **it must be understood in context as a fundamental right, one that enables the exercise of other constitutionally guaranteed rights.**

⁸ Song, Steve. A Starlink ajudará a ampliar a desigualdade global? In Politics, 2025. Available at: <https://politics.org.br/pt-br/acesso-news/starlink-e-desigualdade>. Accessed on: November 10, 2025.

THE DIGITALIZATION OF PUBLIC SERVICES, WHEN NOT ACCOMPANIED BY DIGITAL LITERACY POLICIES AND EFFECTIVE INCLUSION MEASURES, TENDS TO DEEPEN SOCIAL INEQUALITIES

During the development of the Redes na Floresta [Forest Networks] research, interviews were conducted with researchers, journalists, and civil society representatives, who emphasized the foundational role of **internet connectivity as a communication tool and as a gateway to other rights, such as health and education**. Indeed, Brazil is currently undergoing an intense process of government digitalization, which also entails the digitalization of public policies more broadly.

Digital transformation, often reduced to this process of digitalization, as well as the terminology of “Digital Government,” is frequently associated with initiatives aimed at simplifying access to services, strengthening trust and proximity between the State and citizens, and increasing the use and production of meaningful data that could help optimize processes and public policies. In this context, **access to digital technologies and services through the internet has gradually become one of the main ways through which citizens access and exercise their rights**.

The accounts gathered through the interviews conducted by InternetLab showed how the absence of connectivity can, in practice, exclude part of the population from essential services and processes. These can be grouped into the following categories:

RETIREMENT BENEFITS AND BENEFITS FOR FAMILIES LIVING IN POVERTY AND EXTREME POVERTY

Connectivity difficulties prevent some people from accessing retirement benefits or income-transfer programs. With much of the service provision by the National Social Security Institute, or INSS, having migrated to digital channels — through the “Meu INSS” platform, accessed via gov.br — internet access has become crucial so that residents do not need to travel to the city to request benefits or resolve issues and pending matters related to retirement, making the process faster.

In addition to the INSS, access to CadÚnico — the Single Registry for Federal Government Social Programs, which serves as the entry point for social assistance programs such as Bolsa Família, Auxílio Gás, and Minha Casa, Minha Vida — has also undergone a process of digitalization. The migration of services to the online environment, combined with government agencies’ own preference for resolving issues through digital channels, undermines access to basic rights for segments of the population that lack quality internet access.

EDUCATION

Throughout the research, difficulties were reported among young people from Indigenous, quilombola, and extractivist communities in accessing information about university admissions processes. The lack of connectivity in schools and universities affects teachers’ work and the academic lives of students, many of whom do not have internet access at home. The accounts also indicated that the Covid-19 pandemic worsened this exclusion and highlighted connectivity disparities between major urban centers and other municipalities. Community networks have emerged as an alternative for improving access to education, although their small-scale operation remains one of the main obstacles.

HEALTH AND COMMUNICATION

Local interlocutors mentioned the importance of enabling communication for more isolated populations in matters such as the supply and maintenance of equipment, access to medication, transportation for people in need of specialized healthcare, and telemedicine. Connectivity was also identified as important for the management and commercialization of local production chains.

REPORTING VIOLATIONS, TERRITORIAL PROTECTION, AND THE PROTECTION OF DEFENDERS

The internet is also a means through which communities can protect their territories and resources, allowing them to alert public authorities and the media about violations and invasions. Some leaders also reported using the internet to apply for government protection programs.

LEISURE

The interviews show that limited or absent connectivity also reduces the population's quality of life. This involves not only reduced access to the fundamental rights mentioned above, but also restrictions on other forms of consumption and leisure, such as access to films and music.



THE LACK OF ELECTRICITY REMAINS A STRUCTURAL BARRIER THAT PRECEDES THE EXPANSION OF DIGITAL CONNECTIVITY ITSELF

Connectivity is now a fundamental right. **Its full exercise, however, also depends on access to electricity, which remains a structural barrier that precedes the expansion of digital connectivity itself.**

The Brazilian State has made progress in efforts to universalize electricity access. Even so, the Amazon remains the “last mile” of this process. This contradiction is striking: **although the region is responsible for a large share of the country’s renewable energy production, its population does not fully benefit from the resource it helps generate.** In 2021, the states of the Legal Amazon produced more than 27% of Brazil’s electricity, but consumed only 11%, exporting the surplus to other regions.⁹ At the same time, growing energy demand has accelerated the implementation of large-scale projects, whose impacts fall on local communities and territories.

In this context, the way electricity is incorporated into communities becomes a central issue. In some localities, the arrival of electric power is perceived as a form of domination or imposition, since these populations were not previously informed or consulted about whether they wished to receive such infrastructure.

According to representatives of local communities, the arrival of electricity in their territories brought significant changes to social and cultural dynamics. **The concern, therefore, is not with the presence of these technologies in themselves, but with how they are introduced into people’s daily lives. Residents know that the internet — as happened with electricity — has the potential to alter their ways of life. For this reason, they warn about the impacts of implementing connectivity without proper dialogue with the community and without digital literacy initiatives.**

The interviews also revealed concern that connectivity could reduce interest in local culture in favor of online content. This perception is particularly present among older people, who emphasize the importance of preparing young people for a conscious engagement with technology, in order to preserve community ties and avoid isolation.

In light of these concerns, the debate around **community protocols for consultation and free, prior, and informed consent becomes especially important. These instruments of territorial governance, developed by the communities themselves, seek to ensure that any external intervention, whether related to energy, connectivity, or other technologies, takes place through transparent dialogue,** respecting local autonomy and different understandings of development and well-being.

In this scenario, both public officials and civil society organizations recognize that the arrival of the internet triggers profound social transformations. However, no structured public policies were identified to mitigate risks to human rights and local traditions. **Digital literacy initiatives and debates on the effects of connectivity have been led primarily by the communities themselves, social organizations, and researchers, rather than resulting from state policies.**

⁹ SCHUTZE, A.; HOLZ, R. *Retrato da Energia na Amazônia Legal e a Democratização dos Dados*. Climate Policy Initiative, 2023. Available at: <https://www.climatepolicyinitiative.org/pt-br/publication/a-transicao-energetica-na-amazonia-legal/>. Accessed on: August 19, 2024.

STARLINK'S ARRIVAL IN BRAZIL TOOK PLACE IN A FRAGMENTED MANNER, WITHOUT TRANSPARENCY OR PUBLISHED TECHNICAL STUDIES, AND ITS OPERATION REMAINS LARGELY OUTSIDE STATE PLANNING

The adoption of Starlink's low Earth orbit satellites, particularly in the Amazon region, has significantly expanded broadband coverage in areas that have historically faced infrastructural challenges. To understand how the company entered and rapidly expanded in Brazil, InternetLab conducted a survey based on journalistic reporting, mapping the main international, national, and regional milestones in Starlink's trajectory.

Given the absence of official documents and consolidated technical studies, the press was used as an accessible source of information on the company's activities in the country. **This survey, structured as a timeline from 2018 to 2025, revealed a process marked by a lack of state planning, opaque decision-making, and Starlink's own central role in shaping the future of connectivity in remote areas.**

A central milestone in this process was the authorization granted by Anatel in 2022 for the operation of thousands of satellites, without prior public studies on their impacts. Since then, the company's expansion has taken place rapidly, through direct negotiations with national authorities, including meetings with the former President of the Republic, as well as through decentralized initiatives led by states and municipalities. In many cases, journalistic coverage became the main source of information on the company's presence in the country, exposing the fragility of public monitoring mechanisms.

This context shows that the expansion of this technology in the Amazon did not take place primarily through the federal government, but rather through local initiatives led by citizens, regional authorities, or civil society organizations. One example is the creation, in 2022, of the "Conexões Povos da Floresta" initiative, developed by COIAB, CONAQ, and CNS with the mission of connecting Indigenous, quilombola, and extractivist communities in the Amazon. According to a project representative interviewed for the research, Starlink has been the only provider capable of offering quality connectivity at affordable prices in the region.

This overall scenario created favorable conditions for Starlink's rapid expansion across Brazil, especially in the North region and the Legal Amazon. According to Anatel data, the company has already become the leading provider of satellite internet services. In November 2024, nearly 60% of satellite internet subscribers in Brazil were Starlink customers, and around one third of the company's customers were located in the North. States such as Pará and Amazonas account for tens of thousands of connections, with remote localities standing out prominently. In the Legal Amazon, the system quickly reached almost all municipalities: by July 2024, Starlink was present in 96% of municipalities, with antennas installed in 743 of the region's 772 municipalities.¹⁰

The arrival of Starlink and the consolidation of low Earth orbit satellite internet illustrate how private solutions have occupied the gaps left by the absence of consistent public connectivity policies. Although the expansion of this infrastructure has increased access in remote localities, it also introduces new challenges that require deeper reflection. The central issue, therefore, **is not only to expand access, but to ensure that connectivity serves as an instrument for inclusion, respect for regional specificities, and the strengthening of national technological sovereignty.**

¹⁰ Available at: <https://teletime.com.br/16/01/2025/starlink-aumenta-base-no-brasil-veja-quais-estados-tem-mais-clientes/>. Accessed on: September 1, 2025.

FEDERAL PUBLIC POLICIES HAVE ADVANCED IN RECENT YEARS, BUT STILL FACE REGULATORY FRAGMENTATION, OVERLAPPING MANDATES, AND WEAK COORDINATION ACROSS LEVELS OF GOVERNMENT

Connectivity legislation in Brazil is extensive and scattered across different legal and regulatory instruments. It includes broad frameworks that guide public policies aimed at universalizing connectivity, such as the General Telecommunications Law (Law No. 9,472/1997), the decrees establishing the General Plans for Universalization Goals, the Structural Plan for Telecommunications Networks, the Fund for the Universalization of Telecommunications Services (FUST), and the Brazilian Civil Rights Framework for the Internet. These are complemented by a series of specific programs and regulations aimed at connectivity for predefined purposes.

Currently, the main connectivity programs in force in Brazil can be grouped into three major areas: (i) connecting schools, (ii) connectivity in the Amazon/North region, and (iii) connectivity in rural areas.

CONNECTING SCHOOLS

Connectivity in public schools is defended on the grounds that universal access to high-speed internet can improve both learning processes and quality of life. However, this remains a long-standing challenge, marked by both the absence of adequate internet access and the precariousness of available infrastructure.

Among the programs already implemented or currently underway to expand internet access in school environments are:

Broadband in Schools Program (PBLE) — Decree No. 6,424/2008
National Education Plan — Law No. 13,005/2014
Connected Education Innovation Policy (PIEC) — Law No. 14,180/2021
The Connectivity Law — Law No. 14,172/2021
Internet Brazil Program — Law No. 14,351/2022
National Strategy for Connected Schools — Decree No. 11,713/2023
National Digital Education Policy — Law No. 14,533/2023

Overall, the public officials interviewed for the research conducted by InternetLab emphasized a preference for fiber-optic connections, reserving the use of Starlink only for situations in which low Earth orbit satellites are the only viable alternative. The Federal Government, states, and municipalities share a concern with expanding school connectivity, which is reflected in a wide range of programs and initiatives, often overlapping or even competing with one another. Despite these efforts, the projects remain far from ensuring meaningful connectivity, facing obstacles such as discontinuity caused by changes in administration and the lack of clarity regarding the responsibilities of different levels of government.

CONNECTIVITY IN THE AMAZON/NORTH REGION

The expansion of connectivity in the Amazon and in different communities across Brazil's North faces not only the previously mentioned obstacles related to the lack of electricity networks, but also challenges specific to the realities of each state in the Legal Amazon. These include frequent connection failures and the difficulties imposed by the geographical isolation of many municipalities, whose access depends exclusively on air or river transportation.

Considering that each state in the Legal Amazon has its own concerns and geographic and infrastructural specificities, we sought to understand how these issues were being addressed from a legal and regulatory perspective, as well as which connectivity policies and initiatives related to internet access and digital literacy were present in state legislation and projects.

In general, state laws and projects do not specifically address the creation or expansion of connectivity infrastructure policies. Instead, they primarily seek to establish mechanisms for implementing and adapting national guidelines to local contexts. One of the issues that stands out is the discussion around low Earth orbit satellites.

During the period analyzed, the state of Amazonas was the most active in creating laws and measures aimed at improving the quality of connectivity in its municipalities, especially in relation to the debate on low Earth orbit satellites. In consultation with the state legislature, it was noted that contracts signed with Starlink are carried out in a decentralized manner.

CONNECTIVITY IN RURAL AREAS

In addition to the differences among Amazonian states and the infrastructural challenges mentioned in the previous sections, there is also a significant contrast between urban and rural areas. To address these inequalities, Brazil has implemented policies aimed at reducing disparities in internet access and expanding digital inclusion, taking into account territorial specificities as well as the geographic, environmental, and logistical characteristics of different regions. Among the main programs aimed at these contexts are: the Integrated and **Programa Amazônia Integrada e Sustentável (PAIS)** [*Sustainable Amazon Program*] (Decree No. 10,800/2021), the **Projeto Amazônia Conectada (PAC)** [*Connected Amazon Project*] (Interministerial Ordinance No. 586/2015), which is part of the **Programa Norte Conectado** [*Connected North Program*], and the **Programa Rural + Conectado** [*Rural + Connected Program*] (2023).

The main federal policies focused on universalizing connectivity in the North/Amazon region, as well as in other territories considered difficult to access, such as rural areas and parts of the Northeast, prioritize investment in and expansion of infrastructure, especially digital backbone networks, or infovias. However, connectivity challenges are not limited to infrastructure. They also include issues such as insufficient income to pay for internet plans and to purchase devices.

As a result, factors such as the cost of internet access, digital literacy, and quality of access do not appear to be priority issues in the development of connectivity policies for states in the Brazilian Amazon. This gap may compromise the impact and effectiveness of these initiatives, limiting their actual potential to reduce inequalities in access to and meaningful use of digital technologies.

COMMUNITY NETWORKS, WHICH PLAY AN IMPORTANT ROLE IN ENSURING ACCESS IN ISOLATED REGIONS, FACE REGULATORY BARRIERS IMPOSED BY ANATEL THROUGH TECHNICAL CRITERIA THAT FAIL TO FULLY ACCOUNT FOR THE SOCIAL AND POLITICAL DIMENSIONS INVOLVED

Community networks play a fundamental role in ensuring internet access in isolated regions, especially in territories inhabited by traditional communities, where they often constitute the only means of communication and information sharing.

Over the course of its 20-year trajectory, Nupef has developed methodologies and technologies aimed at strengthening the populations most affected by connectivity inequalities. These include community networks and territorial protection networks, implemented with representatives of quilombola, Indigenous, and babassu coconut breaker communities in several Brazilian states, particularly in the Legal Amazon region. These networks are a way of strengthening communities through access to information and the safe use of technology. They help ensure internet access, but are not limited to that: they are communication systems, which may or may not be connected to the internet, and contribute to territorial protection, connectivity, training on technologies and safe internet use, as well as the dissemination of content of public interest.

Despite their relevance, this model faces significant regulatory obstacles, which hinder its consolidation and expansion. Under the **General Telecommunications Law** (*Lei Geral de Telecomunicações - LGT*), Anatel is responsible for managing the resources used for satellite operations, as well as for defining specific requirements and criteria for their use. In this context, the criteria currently established by Anatel to define the type of technology used in its public policies for the North/Amazon region of the country, and more specifically regarding the use of Starlink's low Earth orbit satellites, overlook political, social, and cultural issues related to the use of a given technology. The choice has been based exclusively on technical and financial criteria, prioritizing economic interests and the best possible connectivity within the available resources, to the detriment of adaptation to local realities.

Community networks operate in the territories of traditional communities and may represent the only available means of information sharing. Yet they face difficulties in complying with Anatel's requirements, which limits their viability and expansion.

Although Anatel justifies its authorizations on technical grounds, since the approval of the use of low Earth orbit satellites, the agency has not published robust technical studies to support this decision. The development of multidisciplinary partnerships — involving other public bodies and civil society organizations — could significantly contribute to public policies that are more sensitive to the specificities of these territories.

COMMUNITIES' TECHNOLOGICAL AUTONOMY CANNOT DEPEND EXCLUSIVELY ON STARLINK OR ON COMMUNITY-LED INITIATIVES ALONE

Nupez Institute's experience with the use of Starlink emerged from the intention to identify a more financially viable connectivity solution for communities in territories with limited or no internet access, based on community network initiatives. In these localities, access challenges are significant, and the main available alternative is often traditional satellite connectivity, whose high costs frequently make contracting the service unfeasible, even when expenses are shared among community members.

In this context, Starlink was considered a viable option to test, as it offers continuous connectivity with better signal quality, lower service costs, and deployment flexibility. The assessment conducted by Nupez during the research considered not only the direct cost of the service, but also its ability to consistently meet community needs, with a view to sustainable implementation in the medium and long term. The main points observed were the following:

TECHNICAL ASPECTS

Starlink operates through a constellation of low Earth orbit satellites, approximately 550 km from Earth, with global coverage. Their low altitude enables latency of around 25 ms, in contrast to geostationary satellites, whose latency can exceed 600 ms. The difference is substantial: each data packet travels much faster between the user terminal and Starlink's satellites, resulting in a ratio of approximately 70 complete Starlink trips for every single trip made through a geostationary satellite. This performance allows the end-user browsing experience to come close to that offered by a high-speed terrestrial connection, such as fiber optics. This is particularly crucial for activities that require stability and low latency, such as videoconferencing, telemedicine, distance learning, and other digital services. Starlink also offers a simplified and highly mobile installation process. The equipment included in the kit — router, antenna, and cable — can be easily installed, turned off, reinstalled, and moved within the same territory. The only requirement is that the antenna have an unobstructed view of the sky, allowing it to connect to the satellite constellation. This ease of installation significantly reduces the bureaucratic procedures associated with changing access points. However, internet access in the Legal Amazon faces broader structural challenges that go beyond the technical dimension and reflect economic inequalities, geographic and territorial limitations, and gaps in public connectivity policies. Coverage remains restricted, the signal is unstable, connection costs are high, access to appropriate equipment is limited, and many communities face problems with electricity supply, all of which hinder the universalization of connectivity.

ECONOMIC AND FINANCIAL ASPECTS

The financial barriers are not necessarily related to the monthly cost of the service, but rather to the initial cost of purchasing the installation kits, which include the antenna, router, and cables, not counting other accessories that may eventually be needed and whose cost often exceeds that of a single monthly payment. In addition, the initial cost of the deployment kit requires a relatively high upfront investment. Contracting the service and paying monthly fees can only be done by credit card, and contact with the company is limited to the channel available on its own website.

UNPREDICTABILITY OF STARLINK'S WEBSITE INTERFACE AND PURCHASING PROCESSES

Periodic changes to the user interface of Starlink's website created difficulties for users, as they were not accompanied by detailed guidance or flexibility in configuration. Changes were also recorded in purchasing procedures, documentation requirements, two-factor authentication as a standard requirement, and long delays in the delivery of materials.

STARLINK APP INTERFACE

The app's administrative dashboard was found to have an intuitive interface, allowing for remote network management. The app provides indicators on speed, latency, interruptions, and possible obstructions in the antenna's line of sight, which can be easily understood. However, unexplained interruptions were observed, highlighting the need for ongoing technical support to ensure signal maintenance.

KIT MAINTENANCE

It is currently not possible to purchase individual parts of the Standard Kit separately. This means that if a single component fails outside the warranty period, the only alternative offered by Starlink is to purchase a new complete kit. Records from Nupef's technology team indicate that failures in some equipment begin to occur even before the warranty expires. In these situations, the coverage offered by Starlink is limited, since the company does not assume responsibility for a wide range of incidents, including installation problems, obstructions, manual redirections, electrical failures, external interference, natural wear and tear, or extreme weather conditions. This means that, even during the warranty period, there are several scenarios in which replacement is not guaranteed, leaving users dependent on third-party resellers.

TECHNOLOGICAL COMPATIBILITY

Through the website, users can manage account information, check billing, purchase additional parts or new kits, and control account users with different levels of access, such as administrative, technical, or billing-only access. However, kit configuration and maintenance functions, as well as detailed network monitoring, including signal, performance, latency, connected devices, and interference, are available only through the app. In Nupef Institute's experience, some community managers use mobile phones that do not support the app. As a result, there is no equivalent alternative on the website for managing the kit, increasing dependence on third parties or generating additional costs for communities.

Nupef's experience therefore shows that, in technical terms, Starlink can offer solutions and serve as one type of response to the challenges of expanding connectivity in isolated territories. However, the sustainability of this response depends on several factors that go beyond the availability of the technology itself.

The difficulties involved in keeping the service active are not limited to the community organization required to manage the network. They are also linked to structural barriers, such as regional inequalities, shortcomings in public connectivity policies, and limitations in equipment delivery, all of which directly affect the continuity of these initiatives.

In addition to these barriers, obstacles also arise from Starlink's own operating model. The technical support provided is limited, the payment methods do not take into account the reality of families and populations excluded from the financial credit system, and customer service does not adequately consider

the conditions of these communities. These factors undermine the continuity of the service over time, weakening the community networks that depend on this resource to maintain local internet connectivity.

For this reason, the technological autonomy of these territories and the sustainability of their networks cannot depend exclusively on communities' own initiative to organize themselves and gather resources to maintain internet connectivity infrastructure. They also require the creation of structural and political conditions that ensure their continuous implementation, maintenance, and expansion. Without this support, networks become vulnerable to discontinuity and dependence on a small number of providers. In this context, both Starlink's connectivity services and those offered by other operators should be incorporated into broader political strategies aimed at strengthening local infrastructure.



RECOMMENDATIONS

Based on the analysis of multiple data sources, **we found that the distribution of connectivity in Brazil remains deeply unequal, both in terms of infrastructure and connection quality.**

The research did not aim to offer prescriptive solutions or isolated complaints, but rather to foster interdisciplinary reflection on the topic, integrating not only legal and technical aspects, but also the cultural, social, economic, and environmental dimensions involved. We argue that only through such integration will it be possible to build public policies genuinely committed to social justice and access to rights.

Based on the conclusions of both studies, we present below a set of recommendations aimed at improving public policies for the universalization of connectivity in Brazil. These recommendations should be implemented through coordination among the State, private-sector actors, civil society, and traditional communities:

1. OVERCOMING ENERGY INFRASTRUCTURE AS A BARRIER THAT PRECEDES CONNECTIVITY

The absence or instability of electricity supply remains an obstacle to universal internet access and constitutes a prior challenge to any discussion of digital inclusion in the North region. In this context, **it is recommended that the State recognize the precariousness of energy infrastructure as a structural barrier to internet access**, and incorporate into public policies and legislation on connectivity in the Legal Amazon the potential behavioral and cultural changes that accompany the introduction of new technologies into traditional communities, in accordance with human rights.

2. RECOGNIZING DIGITAL EXCLUSION AS A MULTIDIMENSIONAL PHENOMENON

In many cases, digital exclusion is not manifested only in the absence of connectivity, but also in the precariousness of devices, network instability, high costs, and lack of electricity. **More than expanding coverage, it is essential to rethink the State's relationship with territories and ensure the active participation of communities in the formulation of connectivity policies.** It is also important to structure and strengthen digital literacy initiatives led by local populations and communities themselves, as well as public policies on the topic, especially those aimed at populations historically excluded from digital culture. The debate on access must be understood as a matter of social justice, not merely as an infrastructure issue.

3. CONSIDERING CONNECTIVITY, IN THE DEVELOPMENT OF REGULATIONS, POLICIES, AND INITIATIVES, AS A RIGHT THAT ENABLES THE EXERCISE OF OTHER FUNDAMENTAL RIGHTS

Connectivity is a basic condition for ensuring education, health, and territorial protection, since the digitalization of public services and public policies has turned the internet into a pathway for accessing and exercising citizenship. In this sense, **it is essential to invest in public infrastructure, such as fiber-optic networks and high-speed internet, in order to reduce dependence on exclusively commercial solutions and explore sustainable alternatives for expansion with low environmental impact.** Connectivity should therefore be consolidated as a structuring right, whose realization requires public policies accompanied by digital literacy initiatives, regulation, transparency, and security, especially for vulnerable communities and territories.

4. ADAPTING PUBLIC POLICIES TO THE CULTURAL, TERRITORIAL, AND ECONOMIC SPECIFICITIES OF THE AMAZON

To address the region's connectivity challenges, such as dense forest, dispersed populations, socioeconomic inequalities, and lack of infrastructure, policies must take into account differences among states and between urban and rural areas. They should provide for investments in digital backbone networks, solutions for territories accessible only by air or river, and measures to address income and electricity barriers. In addition, **official surveys should include low-population-density communities, including quilombola, Indigenous, extractivist, and family farming communities**, in order to ensure that policies reflect Amazonian diversity and guarantee equitable access to connectivity.

5. ADDRESSING THE LACK OF STATE PLANNING AND THE OPACITY OF DATA REGARDING STARLINK'S EXPANSION IN THE LEGAL AMAZON

The lack of a national strategy and of transparency in concession and regulatory criteria has led to the premature and decentralized implementation of this technology, deepening inequalities and transferring control over infrastructure to external private interests. Although Starlink is currently the main low Earth orbit internet provider in isolated areas, its operations must be tied to public policies that ensure inclusion, technological sovereignty, and socio-environmental justice. To this end, a regulatory review is needed to **establish clear rules on sustainability, coexistence with other satellite systems, and alignment with international space regulation**, ensuring the equitable and responsible use of these technologies.

6. STRENGTHENING THE COORDINATION OF PUBLIC POLICIES ON DIGITAL INCLUSION

Existing policies and programs could have advanced meaningful connectivity in the Legal Amazon and in Brazil as a whole if they had been implemented in an integrated and coordinated manner. **It is therefore essential for the federal government to consolidate a coordinated, multisectoral strategy guided by the public interest**, involving the State, the private sector, and organized civil society, in order to maximize resources, reduce overlaps, and expand the impact of digital inclusion initiatives.

7. STRENGTHENING THE PARTICIPATION AND AUTONOMY OF LOCAL COMMUNITIES IN THE DESIGN AND IMPLEMENTATION OF CONNECTIVITY POLICIES

Throughout the research, we found consensus on the importance of involving communities in an active and integrated way, taking into account their cultural, territorial, and political contexts. This participation is essential not only to ensure connection quality and the sustainability of strategies, but also to guarantee the equitable distribution of infrastructure and equipment in the most challenging regions, while enabling social monitoring of the impacts of the arrival of the internet in these territories. At the same time, **it is essential to invest in projects and policies that strengthen community autonomy, preparing young people and local leaders to implement solutions such as community networks, expand connection points, and use technologies critically to tell their own stories**. In this sense, expanding digital literacy is a strategic component so that these populations can appropriate the internet safely, consciously, and with the capacity for social transformation.

8. CREATING STRUCTURAL AND POLITICAL CONDITIONS THAT ENSURE THE CONTINUOUS IMPLEMENTATION, MAINTENANCE, AND EXPANSION OF TECHNOLOGICAL INFRASTRUCTURE IN THE TERRITORIES

For autonomy to truly exist, community networks cannot depend exclusively on communities' own initiative to organize themselves and mobilize resources. Consistent public policies and stable financing mechanisms are needed to support the sustainability of these initiatives, guaranteeing technical maintenance, equipment replacement, and technological updating over time.

9. EFFECTIVELY REDIRECTING THE FUND FOR THE UNIVERSALIZATION OF TELECOMMUNICATIONS SERVICES (FUST), ENSURING THAT ITS RESOURCES REACH HISTORICALLY MARGINALIZED POPULATIONS AND ARE NOT CAPTURED BY SECTORAL PRESSURES

The State should seek to strengthen community-based and collaborative connectivity models, supporting initiatives that recognize the self-determination of Indigenous and traditional communities in the control of their own information and technologies. This support should include both technical and financial support for community networks and regulatory frameworks that consolidate these arrangements as a legitimate part of national connectivity policy.





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