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Regulatory perspectives for satellite communications to connect underserved communities

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Regulatory perspectives for satellite communications to connect underserved communities

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Foreword

I am pleased to present this study on regulatory perspectives for satellite communications, with a particular focus on the use of satellites to expand meaningful connectivity for underserved communities. In an increasingly interconnected world, access to information and communication technologies (ICTs) has become essential for advancing social and economic development. Nevertheless, millions of people globally remain excluded from digital opportunities, with the gap widening between connected populations and underserved communities.

Recent advancements in satellite communications have significantly increased capacity, reduced latency, and lowered costs, making these solutions increasingly feasible for bridging connectivity gaps. At a time when deploying traditional terrestrial infrastructure in remote and hard-to-reach areas is often prohibitively expensive, satellite connectivity offers a transformative alternative for advancing digital inclusion.

This report examines and presents policy approaches in five key countries - Brazil, Indonesia, Kenya, Nigeria, and South Africa - to understand how satellite technology is being used to reduce connectivity disparities. The analysis provides valuable insights for policymakers seeking to harness satellite solutions as a core component of strategies for universal digital access in underserved communities.

I recommend this report and checklist to governments and regulators considering the use of satellites as part of a comprehensive public policy approach to achieve universal and meaningful connectivity.

Dr Cosmas Luckyson Zavazava
Director of the Telecommunication Development Bureau
International Telecommunication Union

Executive Summary

This study analyses satellite telecommunications practices across five emerging markets: Brazil, Indonesia, Kenya, Nigeria, and South Africa. These countries have adopted measures to address universal digital connectivity challenges through satellite technology that represent varying stages of satellite market development and regulatory sophistication. Each of these countries faces unique geographical, economic, and political considerations as they navigate the expansion of satellites services, from traditional geostationary orbit (GSO) satellites to emerging satellite opportunities such as non-geostationary satellite orbit (NGSO) constellations.

Through detailed case studies of both successful practices and persistent challenges, this analysis provides valuable insights for policy-makers seeking to leverage satellite technology as a crucial component of universal digital access strategies in emerging markets. The case studies analyse topics regarding the regulatory framework, market dynamics, key policy debates, and implementation challenges of the five key countries.

The cross-country comparison section analyses satellite telecommunications regulation and implementation in the five key countries of the study, highlighting both shared trends and country-specific distinctions. It also analyses other topics across countries such as market dynamics, key policy debates and implementation challenges.

The main barriers to the expansion of satellite connectivity in the countries are:

- **Affordability and funding constraints:** the cost of satellite Internet services and equipment remains high relative to average incomes, especially in rural and underserved areas. All countries face challenges in making satellite connectivity financially sustainable, both for end-users and for government-backed programmes.
- **Digital sovereignty and market concentration concerns:** the dominance of foreign satellite operators and the implications for digital sovereignty, including risks of unilateral service disruption and dependency on external providers.
- **Infrastructure gaps:** limited access to reliable electricity in remote areas is a significant barrier, affecting the deployment and operation of satellite terminals. This is particularly acute in rural regions where grid infrastructure is lacking or unreliable.
- **Technical expertise limitations:** there is a shortage of domestic technical capacity to manage, operate, and maintain complex satellite systems, which affects the sustainability and effectiveness of satellite programmes in all countries.

International experience and recent domestic initiatives suggest that public-private partnerships (PPPs), integration with broader connectivity strategies, multi-technology approaches to universal access, regulatory reforms and flexibility are solutions that can address these challenges:

- PPPs and integration with broader connectivity strategies have been successful and have significantly improved the expansion of satellite technology. In Brazil, Telebras partners with Hughes, Viasat, and Starlink to provide satellite Internet to over 12 000 public facilities, including schools and health centres; in Nigeria, NIGCOMSAT-Eutelsat Partnership leverages low Earth orbit (LEO) satellites to expand coverage while maintaining domestic satellite capabilities; in Kenya, KENET/OneWeb Pilot partnership Connects 15 remote universities via satellite, demonstrating sector-specific implementation; in Indonesia, PT Pasifik Satelit Nusantara (PSN) provides 150 Gbit/s satellite capacity for 50 000 public service points; and in South Africa, Paratus and Eutelsat Konnect deploys satellite-backed Wi-Fi hotspots, offering unlimited data for ZAR 250/month.

- Multi-technology approaches such as the Universal Service Provision Fund (USPF) in Nigeria and government plans that cover Internet connectivity issues nationally, such as the Kenya National Digital Master Plan, or the South Africa Connect (National Broadband Policy and Strategy) are essential to establish goals and solutions for connectivity, including hybrid satellite-terrestrial solutions and expansion for rural and underserved areas.
- Regulatory reforms and flexibility regarding new technologies are very important to adapt the regulatory environment of the country to enable rapid adoption of new satellite services, facilitate market entry for global and local operators, and support integration with broader national connectivity strategies. By streamlining licensing, updating frameworks for emerging technologies such as LEO constellations, and allowing innovative business models, these countries can ensure that satellite solutions are effectively leveraged alongside fibre, mobile, and Wi-Fi to achieve universal access and bridge persistent digital divides.

1. Introduction

In an increasingly interconnected world, access to information and communication technologies (ICTs) has become fundamental to social and economic development. Nonetheless, millions of people across the globe remain disconnected from digital opportunities, creating widening disparities between connected and underserved communities. This digital divide is particularly pronounced in developing regions, where infrastructure limitations, affordability challenges, and gaps in digital literacy exclude vulnerable populations from the digital economy.

This report examines policy practices in five key countries (Brazil, Indonesia, Kenya, Nigeria, and South Africa), aiming to understand how they use satellite technology to reduce connectivity disparities. The report covers the strengths, weaknesses, successes and challenges associated with the use of satellites to provide effective connectivity in underserved areas, with a focus on non-geostationary orbit (NGSO) satellites.

The analysis focuses on the great potential in the use of satellite technology to reduce these disparities. In an era where traditional terrestrial infrastructure faces prohibitive deployment costs in isolated regions, satellite connectivity offers a game-changing alternative for digital inclusion. The recent advancements in satellite communications, including high-throughput satellites (HTS), low Earth orbit (LEO) constellations, and software-defined satellites, have greatly improved capacity, reduced latency, and lowered costs, making satellite solutions increasingly viable for bridging connectivity gaps.

To connect people to technology is also to connect them to opportunities for education, healthcare, financial inclusion, and civic participation that can fundamentally transform lives and communities. Our objective is to identify effective policy mechanisms to accelerate progress toward universal meaningful connectivity, particularly for vulnerable populations, and public facilities such as schools, healthcare centres and others.

The report is organized as follows. The section below summarizes the methodology used during the research. Chapter 2 includes case studies, summarizing key findings, challenges and recommendations for each country. Chapter 3 analyses the case studies to draw insights on market dynamics, ongoing policy and regulatory debates and implementation challenges across countries. Chapter 4 highlights key lessons learned, and Chapter 5 concludes the report with a summary of key findings, challenges and recommendations.

Methodology

This analysis employs qualitative research techniques to provide a comprehensive understanding of public policies implemented by the five key countries examined in the project to improve connectivity in their territory utilizing satellite technology, as well as the challenges faced and the implemented solutions. This information was supplemented with available public data regarding the government's connectivity, as well as market data on device costs and availability of the service.

The qualitative foundation of our analysis rests on interviews held with government and regulatory agencies, relevant experts, and other stakeholders from the five key countries, regarding the implementation and development of policies for using satellites to connect populations and public facilities, such as schools, health centres, municipalities and post offices, in remote and underserved areas, highlighting the social and economic impact.

Through these interviews we gained insights into implementation challenges and institutional capacity requirements, counting on support from government agencies to complement information gaps identified throughout the research process. This practical perspective helps ensure our recommendations are both ambitious and achievable. Complementary research was also carried out, encompassing both domestic and international dimensions.

The international benchmarking component of our methodology focuses on comparing policy approaches across countries with similar challenges or successful interventions, considering the key five countries already mentioned before. Regulatory frameworks, market dynamics, key policy debates and implementation challenges regarding the use of satellite technology to broaden connectivity in underserved areas were evaluated.

2. Case studies

This section provides an in-depth look at how individual countries have approached the expansion of satellite telecommunications. By examining real-world examples of the five key countries, this section illustrates the diversity of regulatory strategies, public-private partnerships, and implementation models employed to overcome barriers such as affordability, infrastructure gaps, and digital sovereignty concerns. These case studies offer practical insights into what has worked, and what obstacles remain, serving as valuable references for policy-makers and stakeholders seeking to design effective satellite connectivity initiatives in emerging markets.

2.1. Brazil

The satellite market in Brazil has gone through significant changes in the past few years. Following a major review of the satellite licensing framework in 2021, the National Telecommunications Agency (ANATEL), the regulator, has faced novel challenges following the growth of satellite constellations, particularly related to digital sovereignty and potential harm to competition. This case study discusses the development of the satellite market in Brazil, the main regulatory issues under debate, and public policies aimed at connecting remote communities and government facilities in underserved areas. In particular, the report covers how the government has allocated funds to connect remote communities, health centres and public schools through GESAC/Wi-Fi Brazil programme and the role that the state-owned operator Telebras has played, following the launch of a state-owned geostationary satellite.

Market overview and development

Brazil's satellite communications market has a mix of domestic operators and global providers. The leading domestic player is Embratel/Claro's Star One, which operates a fleet of geostationary satellites serving Brazil and Latin America. Another key domestic entity is Telebras, the state-owned telecommunication company, which operates the SGDC-1 (geostationary defence and communications satellite) launched in 2017[1]. In addition, Hispamar/Hispasat (Spanish) and SES, Intelsat, and Eutelsat (global operators) provide geostationary capacity over Brazil for television, telecommunication trunking, and broadband services.

In recent years, focus has shifted to non-geostationary orbit (NGSO) systems, especially LEO constellations. Starlink (SpaceX) began operating in Brazil after receiving ANATEL authorization[2] in early 2022[3], deploying low-latency, high-speed broadband via thousands of LEO satellites. OneWeb obtained a 15-year landing rights licence in 2022[4] and is establishing two gateway stations in Brazil to deliver its low-latency connectivity, supporting both commercial users and government connectivity initiatives.

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1 https://merege.com.br/business_case/telebras-fab-sgdc-1-sgdc-2

2 Under the licensing regime in Brazil, the requirements for Brazilian and foreign satellites are different. Both Brazilian and foreign operators must obtain a Satellite Landing Right licence, which grants the right to use spectrum and orbital resources (ANATEL Regulation 748/2021). Foreign satellites must present documentation from their home country's regulatory agency, with a sworn translation into Portuguese and they have to establish a company organized under Brazilian law to act as their legal representative in the country.

3 https://www.gov.br/anatel/pt-br/assuntos/noticias/anatel-autoriza-exploracao-de-satelites-por-spacex-e-swarm

4 https://www.satellitetoday.com/government-military/2022/07/05/oneweb-receives-regulatory-access-to-provide-broadband-in-brazil/

Looking ahead, Amazon Project Kuiper is expected to start operating commercially in 2026[5] and Canada's Telesat Lightspeed by 2027[6].

Market share dynamics

The entry of LEO broadband constellations has significantly altered competition. HughesNet (Hughes Network Systems), which launched consumer satellite Internet in Brazil in 2016, was the market leader with coverage in over 5 000 municipalities[7] using high-throughput geostationary satellites. However, the arrival of Starlink in 2022–2023 changed the playing field of the satellite communication market in Brazil. By late 2023, Starlink had grown to become the largest satellite broadband provider for individual consumers in Brazil[8], surpassing HughesNet's subscriber count. Meanwhile Viasat, via its partnership with Telebras SGDC-1, provides broadband to both government and some retail users. Traditional geostationary operators such as Embratel Star One focus on enterprise, cellular backhaul[9] and broadcasting.

Table 1: Number of subscribers and share of the five largest satellite operators, from 2022 to 2024 (ANATEL)

Operators	Dec. 2022	Dec. 2023	Dec. 2024
Starlink	11 602 (3.6%)	132 958 (32.5%)	326 807 (58.0%)
Hughes	201 204 (62.0%)	180 755 (44.2%)	171 211 (30.4%)
Viasat	31 884 (9.8%)	29 363 (7.2%)	20 379 (3.6%)
Telebras[10]	25 652 (7.9%)	24 309 (5.9%)	17 618 (3.1%)
Claro	22 022 (6.8%)	20 640 (5.0%)	12 111 (2.1%)

5 https://teletime.com.br/09/10/2025/amazon-kuiper-busca-parceiros-na-america-latina-e-aposta-em-intergracao-com-aws/
6 https://teletime.com.br/20/03/2025/brasil-e-canada-negociam-cooperacao-no-mercado-de-satelites/
7 https://news.satnews.com/2021/07/27/celebrating-5-years-in-brazil-hughes-expands-digital-services-throughout-the-country
8 See footnote 4.
9 Examples of partnerships between satellite operators and mobile operators for this purpose include those between TIM and Gilat, and Telefonica and Telesat. https://www.tim.com.br/sobre-a-tim/sala-de-imprensa/press-releases/institucional/tim-implementa-maior-rede-de-backhaul-via-satelite-da-america-latina-com-mais-de-sites and https://www.telesat.com/wp-content/uploads/2022/05/Telefonica-GS-PR_Final_Portuguese.pdf
10 Telebras does not provide retail services. These figures include service provision to enterprises and government agencies.

In terms of pricing, Starlink offered as of early March 2025 a plan for end users with a monthly subscription of ZAR 236 (USD 41.60)[11], with no data cap[12]. The terminal device costs ZAR 2 400 (USD 432).

Hughes, the second largest satellite operator, charged as of March 2025 a monthly subscription of ZAR 179 (USD 31.54), with a data cap of 50 GB. Subscribers must pay a one-off activation fee of ZAR 129 (USD 22.73)[13].

On the other hand, the third largest operator Viasat offered as of March 2025 access to Internet services with a 200 GB data cap for ZAR 399 (USD 70.32) per month. The activation fee costs ZAR 199 (USD 35.07). Meanwhile, Claro offers monthly subscription plans starting at ZAR 119.90 (USD 21.13) for data and at ZAR 99.90 (USD 17.60) for home broadband. Other options with lower quality and data cap are also offered for lower prices starting at ZAR 59.90/month (USD 10.55). Telebras has a distinct role from other commercial operators and does not directly compete in the mass retail market, providing instead services supporting government connectivity projects and wholesale services to local ISPs that serve end users.

All four commercial offers represented a significant percentage of the minimum wage in the country (ZAR 1 518 In 2025, USD 267.54), making it difficult for low-income families to purchase satellite Internet services without significant data caps[14].

Recent developments

Since 2019, there has been a transition from GSO-centric to NGSO-inclusive services. ANATEL approved applications for licences[15] from multiple LEO constellations, breaking the historic dominance of GEO-based ISPs. The consumer market for satellite Internet has expanded, with higher speeds and lower latency now available, while enterprise/government demand is met through a mix of GEO (for broad coverage) and NGSO (for performance-critical needs). This new market dynamism benefits end users but also raises questions about spectrum sharing and the long-term role of domestic infrastructure (e.g. SGDC) amid global players – a theme picked up in regulatory and policy discussions.

There is currently only one LEO satellite provider fully operational in Brazil offering retail broadband services[16]. Nevertheless, other LEO constellations are expected to offer broadband

[11] Currency rate at 1 USD = 5,67 BRL (Central Bank of Brazil PTAX fee), as of 25 April 2025.

[12] In late March 2025, Starlink reportedly informed customers subscribing to Priority packages that their upload and download speeds would be reduced to 0.5 Mbit/s and 1 Mbit/s once their data cap is reached, unless they buy extra data allowances. Priority packages guarantee higher data speeds. Residential customers typically do not subscribe to Priority packages, making this change less likely to affect them.

[13] Consumers using services based on satellite constellations typically enjoy a better experience. Starlink offers a service with an average download speed of 67 Mbit/s in the country in 2024, while consumers using services based on geostationary satellites tend to browse with lower speeds. For example, Hughes delivered an average download speed of 10 Mbit/s to consumers in Brazil in 2024. Source: presentation shared during interview with ANATEL. Similarly to download speeds, the average latency offered by satellite constellations enables a better user experience, compared to geostationary satellite service providers.

[14] In late March 2025, Starlink reportedly announced a commercial offer to provide a 10 GB data allowance for USD 10 for current users that own terminal devices. This offer is only available to ongoing customers, i.e. customers must purchase a more expensive package before buying the 10 GB data allowance.

[15] Besides landing rights, satellite providers must also apply for an individual licence for provision of telecommunication services to offer retail services in the country.

[16] This is Starlink. The company started operating with 4,408, following the approval of landing rights in 2022. In April 2025, ANATEL authorized the satellite provider to increase its constellation by 7,500 satellites. See more at: https://www.gov.br/anatel/pt-br/assuntos/noticias/anatel-aprova-alteracao-do-direito-de-exploracao-do-sistema-starlink-e-emite-alerta-regulatorio

services in the next few years, including: Amazon Kuiper, from 2026[17]; OneWeb, from 2026[18]; SpaceSail, from 2026[19]; Telesat, from 2027[20].

In April 2025, ANATEL published an updated list ranking[21] non-geostationary satellite constellations according to their level of protection. Constellations placed higher on the rank receive stronger protection in cases of harmful interference from other systems – a key element satellite providers consider to coordinate and compete with other satellite systems.

The Ministry of Communications and Telebras signed memorandums of understanding (MoUs) with China and Spain, respectively where SpaceSail and Hispasat are based. According to the MoUs, both foreign operators would explore demand for data services in remote areas in collaboration with Telebras. In 2024, Hispasat announced a "multi-orbit" strategy to continue developing its business model in the country. SpaceSail reportedly expects to start providing Internet services in Brazil from 2026.

Regulatory framework and evolution

Institutional framework

Brazil's satellite sector is overseen by a clear institutional arrangement. The Ministry of Communications (MCom) sets national connectivity policy and programmes (such as GESAC/Wi-Fi Brasil for universal access). The National Telecommunications Agency (ANATEL) is the telecommunication regulator, including for the purpose of spectrum management and licensing of satellite services. Telebras, a state-owned telecommunication operator, provides commercial wholesale services and may receive government funding to achieve public policies targets set by MCom. For example, following guidance from the ministry, Telebras implemented strategic projects such as the launch of a government-owned satellite[22] and expanding fibre-based backhaul networks to underserved areas.

Legal and regulatory structure

Satellite must obtain the following licences to operate:

- Landing rights to provide satellite capacity in the country.[23]
- An individual licence for service provision, if they provide retail services.[24]
- Licenses for all satellite Earth stations, including gateways.[25]

17 https://teletime.com.br/09/10/2025/amazon-kuiper-busca-parceiros-na-america-latina-e-aposta-em-intergracao-com-aws/
18 https://www.mobiletime.com.br/noticias/03/10/2024/kuiper-brasil/
19 https://telesintese.com.br/governo-espera-inicio-da-operacao-da-spacesail-no-brasil-em-2026/
20 https://teletime.com.br/20/03/2025/brasil-e-canada-negociam-cooperacao-no-mercado-de-satelites/
21 https://sei.anatel.gov.br/sei/publicacoes/controlador_publicacoes.php?acao=publicacao_visualizar&id_documento=15205670&id_orgao_publicacao=0
22 Satélite Geoestacionário de Defesa e Comunicações Estratégicas, SGDC.
23 To obtain landing rights in Brazil, Brazilian satellites undertake orbital slot coordination via ANATEL before ITU. Foreign satellite systems simply demonstrate they coordinated orbital slots from their own jurisdiction. See more details at: https://www.gov.br/anatel/pt-br/regulado/satellite/process-for-granting-satellite-landing-rights
24 https://www.gov.br/anatel/pt-br/regulado/outorga/comunicacao-multimidia
25 https://www.gov.br/anatel/pt-br/regulado/satellite/process-for-granting-satellite-landing-rights

All operators must comply with spectrum allocations and antenna and terminal certification rules.

Historically, licensing requests have been assessed on a first-come, first-served basis. In January 2022, the ANATEL board approved the first LEO constellation licenses for provision of retail broadband services, granting landing rights for Starlink to operate 4 408 satellites in Brazil through March 2027[26]. OneWeb landing rights, granted in mid-2022, have a 15-year term[27].

A satellite landing right authorizes the use of spectrum and orbital resources for satellite communications and the provision of satellite capacity within the Brazilian territory. For both new applications and modifications (such as adding spectrum bands to operate), ANATEL charges a fee of ZAR 102 677 (USD 18 096.69)[28]. The same fee applies regardless of the frequency bands involved or the validity period. Each authorization is granted for up to 15 years and can be renewed for additional 15-year periods. The same fee is charged to assess requests for a licence renewal or extension.

Companies must start operating with a deadline linked with technical and regulatory requirements established by ANATEL based on its Operating Right Assignment Rules. After companies start operating, an Installation Inspection Fee (TFI) of ZAR 26,816 (USD 4,726.28) is charged[29] both for GSO and NGSO operations per satellite or system[30]. For earth stations, ANATEL charges ZAR 26.83 (USD 4.73) for terminal devices and VSATs (with antenna diameter lower than 2.4 metres); ZAR 3,352 (USD 590.78) for Satellite News Gathering Station; ZAR 402.24 (USD 70.89) for Central Earth Station; and ZAR 13 408 (USD 2 363.14) for large Earth stations with antenna diameters larger than 4.5 metres[31].

The Annual Operating Inspection Fee (TFF) is equivalent to 50 per cent of TFI and is mandatory for GSO and NGSO space stations. Additional fees include the Contribution for the Promotion of Public Broadcasting (CFRP) and the Contribution for the Development of the National Cinematographic Industry (Condecine), also paid by both GSO and NGSO stations, which combined are equivalent to 50 per cent of TFI.

ANATEL has been actively updating its regulatory framework to accommodate NGSO constellations. In October 2021, it issued Resolution 748/2021, modernizing satellite service licensing and bringing it under the General Telecommunications Law of 1997. In 2023, the regulator approved guidelines for NGSO systems, addressing issues such as spectrum sharing and competitive fairness[32]. For example, the rules required running a public consultation before granting or extending NGSO landing rights to ensure transparency and address interference and competition concerns. This example illustrates how ANATEL has tackled the challenge of fostering innovation and investment in LEO networks while preventing "dumping" or interference issues and maintaining a level playing field.

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26 https://agenciabrasil.ebc.com.br/geral/noticia/2022-01/anatel-aprova-operacoes-da-rede-de-satelites-starlink-da-spacex. In January 2022, ANATEL also granted landing rights for Swarm IoT nanosatellite network through 2035.
27 See footnote 5.
28 Article 38 of the General Regulation on Satellite Exploration (Resolution n. 748/2021).
29 Item 29 of Annex I, Law n. 5070/1966 (Fistel Law).
30 In case of a constellation.
31 Ibid.
32 ANATEL Ruling 4430 of 2023, available at: https://informacoes.anatel.gov.br/legislacao/index.php/component/content/article?id=1865

Spectrum allocation in Brazil follows the ITU Radio Regulations, with ANATEL assigning frequency bands for satellite use (C, Ku, Ka, X, etc.) and issuing spectrum licenses to operators. ANATEL coordinates filings internationally to avoid interference[33]. In 2023, Brazil took a leadership role in ITU forums on space sustainability and cost recovery, advocating revised fee structures for large constellations to reflect their burden on coordination processes[34].

Regulatory sandboxes

The ANATEL regulatory sandbox programme creates a controlled environment for testing innovative business models that are currently non-compliant with the regulatory framework. There are several projects approved under the regulatory sandbox regime currently ongoing, including among others one testing how standard smartphones could communicate directly with satellites (direct-to-device, D2D).

Mobile operators have shown initial interest in testing this technology, and the first test reportedly took place in March 2025. The mobile and satellite telecommunications sectors have perceived themselves as competitors to some extent in Brazil, and the business model to collaborate in the provision of direct-to-device services seems to be unclear.

Market access requirements

The regulatory barrier for satellite operators has lowered in the past few years. Under ANATEL Resolution 220 of 2000[35], the standard process for granting Brazilian satellite landing rights required a public procurement process, which could only be waived under specific conditions.

Under ANATEL Resolution 748 of 2021[36], by default ANATEL will assess applications for landing rights on a first-come, first-served basis, making it easier for the private sector to enter the market.

ANATEL requires landing-rights holders to offer services in Brazil (not just overfly). Landing-rights holders must also pay administrative fees and contribute to Brazil's FISTEL/FUST funds[37].

Public policy and universal access initiatives

Brazil faces a significant connectivity challenge due to its vast and diverse geography, which includes many rural and remote areas that are difficult to reach with traditional broadband infrastructure such as optical fibre, cable networks or microwave links.

While 4.7 per cent of all schools in Brazil (6 467 out of 137 914 schools) do not have access to Internet services, the percentage of unconnected schools in rural areas is much higher, 11.7 per

33 See footnote 20.
34 https://www.gov.br/anatel/pt-br/assuntos/noticias/atuacao-internacional-da-cbc-2-no-primeiro-quadrimestre-de-2024
35 https://informacoes.anatel.gov.br/legislacao/resolucoes/2000/161-resolucao-220
36 https://informacoes.anatel.gov.br/legislacao/resolucoes/2021/1595-resolucao-748
37 Landing-rights holders must contribute to the universal service fund (FUST) if they provide voice or data services to end users. There is no obligation to contribute If they only provide satellite capacity to other companies. More details at: https://www.planalto.gov.br/ccivil_03/leis/l9998.htm. Satellite companies contribute to the FISTEL fund through administrative fees paid to ANATEL, e.g. to assess a landing rights request or certify antennas. FISTEL is used to foster research and development in the telecommunication sector in the country. See more details at: https://www.planalto.gov.br/ccivil_03/leis/l5070.htm

cent (6 012 out of 51 202 schools)[38]. Satellite has potential to become a key solution to bridge this digital divide, connecting homes, businesses, and public institutions in underserved areas.

Notably, even for schools already connected by some technology (95.3 per cent), only 40.4 per cent (55 758 out of 137 914 schools) are connected with appropriate speed for usage by students in a classroom.

Approximately 18.9 per cent (26 063 out of 137 914 schools) are connected with "appropriate speed" according to ANATEL[39] for usage by teachers, the staff and occasionally by students.

Various public policies support the current connectivity of schools, and its improvement in the coming years. There are three main sources of funds to connect underserved areas and government facilities, including public schools:

- Federal budget, under the GESAC/Wi-Fi Brazil programme (see more details below).[40]
- Universal service fund (FUST).
- Funds from investment commitments imposed by a 2021 spectrum auction[41].

All three sources of funds are used in practice to connect communities and various government facilities in underserved areas with satellite technology.

For example, satellite technology is used to connect government facilities through the following policies:

- Under the GESAC programme, Telebras in partnership with SES have connected more than 1 500 Internet access points for government facilities in Brazil's Northern Region since April 2024[42].
- An independent entity implementing investment commitments imposed by a 2021 spectrum auction, EACE already launched tenders to connect 24 000 public schools by the end of 2025. Upcoming tenders are expected to connect additional 10 000 public schools, totalling 34 000 schools to be connected with an investment of ZAR 3.1 billion (USD 557.5 million as of June 2025), all technologies considered. EACE estimates that satellite technology will be used to connect 18 895 public schools[43] (55.6 per cent of all schools connected under this initiative).

In a separate initiative, the Brazilian Ministry of Communications launched tenders to connect public schools with terrestrial networks. In total, the Brazilian government expects to invest ZAR 6.5 billion (USD 1.17 billion as of June 2025) to make connectivity available for 137 000 schools by the end of 2026, including all technologies.

38 https://informacoes.anatel.gov.br/paineis/infraestrutura/conectividade-nas-escolas

39 https://informacoes.anatel.gov.br/paineis/infraestrutura/conectividade-nas-escolas

40 According to the Brazilian Ministry of Communications, 11 068 schools were connected by various public policies as of May 2025, including 9 000 schools using satellite technology through the GESAC programme. https://www.gov.br/mcom/pt-br/acesso-a-informacao/acoes-e-programas/programas-projetos-acoes-obras-e-atividades/wi-fi-brasil/conexao-de-escolas. Apart from the federal budget itself, congressmen can designate additional funds to connect additional public service points through "parliamentary amendments". These funds are typically executed by the Ministry of Communications.

41 Particularly the multi-band spectrum auction held in 2021 required investment commitments from winning bidders. Implementation of connectivity for schools is managed by EACE, an independent agency funded by operators and overseen by ANATEL.

42 Internet access points connect public institutions, schools, libraries, telecentres, health units, indigenous villages and rural settlements across the country's Northern Region. Data reported by SES as of December 2024.

43 4645 schools connected during phases 2 and 3, and 50% of 28,500 schools to be connected during phase 4.

Quality of service requirements to connect public schools vary depending on the technology used:

- Schools connected with satellite technology have a minimum of 20 Mbit/s download speed;
- Schools connected with other technologies have download speeds ranging from 50 Mbit/s to 1 Gbit/s depending on the number of students.

GESAC / Wi-Fi Brasil programme

One of the key policies leveraging satellite connectivity in the country is the Governo Eletrônico – Serviço de Atendimento ao Cidadão (GESAC) programme, rebranded as Wi-Fi Brasil. This programme is the cornerstone of Brazil's universal satellite Internet access policy. Launched in 2002 and now overseen by the Ministry of Communications, GESAC provides free broadband via satellite to schools, health posts, and other public or community sites in remote areas[44].

As of mid-2023, the programme had contracted a total of 28 000 points[45] to be deployed over the five-year contract period (through 2028), with approximately 12 000 points already operational by early 2024. Of these, approximately 6 800 points (including 5 400 schools) are funded directly through the Ministry of Communications' budget, with the remainder financed through parliamentary amendments and agreements with other ministries. The new GESAC contract, signed in December 2023, provides improved service with a minimum speed of 20 Mbit/s (doubled from the previous 10 Mbit/s) and offers tiered options up to 60 Mbit/s with community Wi-Fi capability[46]. This contract allows Telebras to serve as a satellite integrator, contracting capacity from multiple operators beyond just the SGDC satellite, which has reached full capacity in the northern and northeastern regions[47].

The most significant recent development came in 2024, when the Monitoring Group for School Connectivity Projects Funding (GAPE) approved the "Novo GESAC" proposal[48], which will fund satellite Internet for approximately 20 000 additional schools in remote areas. These new connections will target schools located more than 10 kilometres from fibre-optic networks across every region of Brazil, effectively doubling the number of connected schools.

To monitor connectivity of public schools and health centres, the government makes certain dashboards available, which are complemented by regular surveys run by CETIC.br from NIC.br[49].

44 https://www.gov.br/mcom/pt-br/acesso-a-informacao/acoes-e-programas/programas-projetos-acoes-obras-e-atividades/wi-fi-brasil

45 A point is a physical location where a broadband internet connection is installed, usually with Wi-Fi infrastructure available for common use. It can be: 1) a public school (educational unit); 2) a basic health unit; 3) a public library; 4) a telecentre; 5) a traditional community (e.g. quilombola or indigenous village); 6) another strategic public facility. Each point represents an individual internet access installation, whether via satellite or terrestrial connection, with a router and, often, an internal Wi-Fi network.

46 Interview with the Ministry of Communications.

47 A key element of the program's financial management is that Telebras only receives payment for points that are actually operational. This performance-based payment model requires Telebras to provide photographic evidence of installation and connection testing, and the Ministry uses the management system to verify that each point is functioning before authorizing payment, ensuring efficient use of public resources.

48 Funds managed by GAPE originate from obligations imposed over licensees of spectrum auctioned for 5G in 2021.

49 The most relevant sources are: ANATEL Dashboard and Gesac Dashboard. Regular surveys covering health centres and public schools include: ICT in Education (NIC.br) and ICT in Health (NIC.br). Public schools and health centres also installed a device to monitor the quality of connections (see Connected Education Meter and Connected Health Meter).

The GESAC/Wi-Fi Brasil programme relies on a diverse funding model combining the Ministry budget allocation[50] (supporting approximately 6 800 points, including 5 400 schools), parliamentary amendments (which allow legislators to direct funds to specific regions), and Decentralized Execution Terms (TEDs) with other ministries such as education, health, and social development. This multi-source approach provides greater resilience against budget fluctuations.

Telebras and the SGDC programme

Telebras is the operational backbone of Brazil's public satellite Internet initiatives. It owns the SGDC (Satélite Geoestacionário de Defesa e Comunicações Estratégicas), which has 58 Gbit/s of Ka-band capacity for civilian broadband plus X-band for military use[51]. Telebras was tasked with using SGDC to further the National Broadband Plan (PNBL) and connect government offices and underserved communities[52].

PNBL original targets (2010-2014) were 30 million wired broadband connections by 2014. However, by May 2014, the actual number reached was 23.2 million. The target for mobile broadband was 60 million connections by 2014, but this was surpassed, reaching 127.2 million connections by May 2014. From Q4/2010 to Q2/2013, the number of cities covered by broadband jumped from 681 to 2 930, and the Telebras network reached 612 municipalities, covering about 40 per cent of the population.

The Geostationary Satellite for Communications and Defence (SGDC), operated by Telebras, was launched in 2017 with three main objectives: 1) reduce Brazil's digital divide by delivering high-quality Internet coverage nationwide under the PNBL; 2) provide secure communication channels for government and defence; 3) advance Brazil's space technology capabilities. The satellite allocates about 70 per cent of its capacity (Ka-band) for civilian broadband expansion and 30 per cent (X-band) for military and government use.

Besides providing Brazil with greater autonomy in civil and military communications, the SGDC has also had significant results furthering the PNBL. There has been expansion of connectivity points, in partnership with programmes such as GESAC, which has enabled the deployment of more than 11 000 connectivity points throughout Brazil, particularly benefiting public rural schools and remote communities.

As of 2024, over 1 500 new Internet access points have been implemented in the Northern Region alone, connecting public institutions, schools, health units, indigenous villages, and rural settlements.

According to the Ministry of Communications, up until 2023 SGDC transmitted Internet signals to antennas installed at 18 839 locations, benefiting residents of 2 977 municipalities. More than 14 700 rural and indigenous public schools have broadband Internet via the satellite, in addition to health centres, settlements, indigenous, quilombola, and riverside communities, and community telecentres.

[50] The programme monthly operational costs are substantial, with the Ministry paying approximately BRL 9 million per month for the points under its direct responsibility.

[51] See footnote 2.

[52] See footnote 2.

Considering its limited retail reach, Telebras in 2018 entered a public-private partnership with Viasat[53]: Viasat provided ground infrastructure (gateway stations, user terminals) and expertise to commercialize SGDC capacity, while Telebras supplied the satellite bandwidth[54]. This partnership enabled the rapid rollout of Wi-Fi Brasil sites, reaching a milestone of 50 000 sites connected across Brazil. More than 20 000 Internet access points were established specifically through the Wi-Fi Brasil programme, in partnership with Telebras and using the SGDC-1 satellite. About 10 000 are located in rural and indigenous schools, health centres, other public service facilities, and non-profit organizations offering access to local communities. The Telebras-Viasat model is a wholesale one: Telebras effectively leases capacity to Viasat who then provides services to retail customers, e.g. households in urban and rural areas. This arrangement also helped monetize the SGDC, offsetting its USD 400 million cost with revenue-sharing, and established a template for future satellite PPPs in Brazil. The expectation of initial revenue-sharing was of USD 1 billion in 10 years, counting from 2018[55].

Telebras has broadened its partnerships over time. The Telebras strategy is to ensure service continuity by collaborating with global satellite operators on Brazil-focused capacity, while maintaining ownership of the customer relationships for government programmes. In 2024, Telebras contracted SES to use the new SES-17 high-throughput GEO satellite to serve additional GESAC sites[56]. Telebras initially considered launching an additional satellite (SGDC-2) to increase satellite capacity and replace the current satellite in the long term, but the launch date is undefined so far.

Key findings

In summary, Brazil's public policy has made satellite broadband a linchpin of its digital inclusion strategy, achieving widespread connectivity to schools and communities that terrestrial networks still do not reach. The combination of strong political commitment, a national asset (SGDC), and partnerships with private experts has brought meaningful results.

Brazil's experience shows that a convergence of government initiative and private innovation can rapidly expand connectivity, e.g. Viasat-Telebras partnership and Telebras-SES partnership in collaboration with the GESAC programme.

Key factors for these results include:

- **proactive public investment**: Brazil made significant strategic investments in satellite capacity through the SGDC (Geostationary Satellite for Defence and Strategic Communications) programme. This government-led initiative ensured national coverage, particularly focusing on underserved regions that commercial providers had neglected. The government also consistently funded the GESAC programme, providing connectivity to public facilities across the country, with special emphasis on schools in remote areas and indigenous communities.
- **regulatory openness to new technologies**: Brazil's regulatory framework has evolved to become more adaptive to a fast-changing environment, embracing new satellite technologies, particularly with the creation of a regulatory sandbox for direct-to-device satellite services. ANATEL (Brazil's telecommunication regulator) implemented simplified

53 The combination of lack of significant business development before the satellite launch and limited retail reach made signing a partnership with a private enterprise a good solution to use satellite capacity in the short term after the satellite was launched. The SGDC has a lifetime estimate of 18 years.

54 See footnote 2.

55 In 2024 Telebras reported a net revenue of ZAR 414.3 million (USD 73,5 million as of 5 June 2025).

56 Ibid.

authorization processes for satellite operations, reduced licensing fees for satellite services, and eliminated the requirement for public bidding for satellite authorization. These changes created a more flexible environment for innovation and market entry.

- **public-private partnerships (PPP)**: Brazil has developed effective collaboration models between public entities and private satellite operators. The Telebras model of serving as a satellite integrator allows the state-owned company to contract capacity from various commercial satellite providers while maintaining government oversight. The 2021 regulatory change allowing cooperation agreements (ACTs) between GESAC and other entities has expanded service reach by enabling direct contracting between satellite service providers and government agencies or educational institutions.
- **universal access policy continuity**: Brazil has maintained the GESAC programme since 2002, consistently expanding its scope and reach while adapting to technological changes. The programme evolved from terrestrial connections to purely satellite-based connectivity, and recently increased minimum speeds from 10 Mbit/s to 20 Mbit/s. This long-term policy consistency has allowed for gradual improvements and expansion of satellite-based connectivity services for schools, healthcare centres and other public service points across diverse geographical challenges.

Challenges

Despite the significant progress made, the following challenges remain:

- **spectrum and orbital resource management**: Brazil faces increasing competition for limited orbital slots and spectrum resources as satellite constellations multiply globally. The country must balance national strategic interests with the increase in satellite companies wishing to offer their services in Brazil, and always considering the international coordination requirements at ITU, particularly as more LEO constellations seek market access. ANATEL management of these scarce resources requires continuous updating and evaluation to take into account the next-generation satellite technologies while ensuring efficient use and preventing harmful interference between systems.
- **ensuring affordability and inclusion**: While satellite connectivity has expanded significantly in Brazil, affordability remains a barrier for many communities and institutions. Data caps and usage limitations on satellite services can restrict the value of connectivity, particularly for educational applications requiring video streaming and large file transfers. The price differential between satellite and terrestrial connectivity options remains substantial, requiring continued subsidy mechanisms to bridge the digital divide in remote regions.
- **financial sustainability and relevance for Telebras, once commercial LEO options are ubiquitous**: As commercial LEO operators capture market share with lower latency and higher throughput services, Telebras faces challenges maintaining its relevance and financial viability. For example, Telebras could consider specializing in critical infrastructure, security-sensitive applications, or serving as a government satellite integrator to leverage its unique position as a neutral public entity.
- **technology refresh for the national satellite options (SGDC-2 or alternate capacity), including a more targeted demand forecast and detailed business plan**: The current SGDC satellite has capacity limitations, particularly in high-demand regions such as the Amazon and Northern Region. Any successor satellite or capacity acquisition requires more precise demand mapping to avoid the misalignment that occurred with the original SGDC deployment. A comprehensive business plan must account for rapidly evolving technology, shifting demand patterns, and the competitive landscape of new satellite entrants.

- **addressing sovereignty aspects**[57]**, considering the current market concentration of satellite capacity**: Brazil's reliance on foreign satellite operators raises strategic concerns about control of critical communications infrastructure. Moreover, dominance in certain markets by a single operator may create vulnerabilities in terms of service continuity, data security, and pricing power. Despite having a simplified licensing framework that encourages market entry, the country must develop a balanced approach that leverages foreign technological capabilities while maintaining sufficient domestic control over essential communication pathways, particularly for government services, education, healthcare, and defence applications.

2.2. Indonesia

Market overview and development

Market structure

Indonesia's satellite communications market is driven by its vast archipelago geography, which creates a high demand for satellite connectivity to reach remote islands and regions not served by terrestrial networks. In 2020, Komdigi (*Kementerian Komunikasi dan Digital,* the Ministry of Communication and Digital Affairs of Indonesia) conducted an internal study on the projected supply and demand of satellite capacity in the country, particularly for communications. The study's results indicated an expected demand of up to 1 terabit per second (Tbit/s) by 2030. However, the study has not indicated the emerging technologies of NGSO satellites. The current satellite supply accounts for only 30 per cent of the estimated demand, encompassing both domestic and foreign satellite capacity.

Currently, there are six local satellites operated in Indonesia, which provide broadband and broadcasting services, namely MERAH PUTIH (108°E) operated by PT Telkomsat; MERAH PUTIH 2 (113°E) operated by PT Telkomsat; MERAH PUTIH 3 (134°E) operated by PT Telkomsat; SATRIA-1 (146°E) operated by PT PSN; TELKOM 3S (118°BT) operated by PT Telekomunikasi Indonesia; NUSANTARA SATU (146°E) operated by PT PSN. One local satellite, BRISat, is operated by PT BRI (PT Bank Rakyat Indonesia) only for providing BRI banking services (not for commercial use). Additionally, Indonesia also has three earth exploration satellites in low Earth orbits managed by the National Research and Innovation Agency (BRIN).

The Government of Indonesia, through BAKTI (*Badan Aksesibilitas Telekomunikasi dan Informasi,* Telecommunication and Information Accessibility Agency), already started working to launch twin geostationary satellites designated as SATRIA-2A and SATRIA-2B, designed to deliver a combined capacity of 300 Gbit/s [58] – double the capacity of the earlier SATRIA-1 satellite, which operates at 150 Gbit/s. The initiative aims to serve Internet access for educational facilities, local government, defence and security administration, and health facilities throughout the country.

Market dynamics and recent developments

There has been a shift in technology from traditional Geostationary (GSO) satellites to non-geostationary (NGSO) constellations. The primary operators of the GSO satellite in Indonesia are

[57] https://teletime.com.br/10/03/2025/anatel-avalia-impacto-de-expansao-da-starlink-na-soberania-digital-do-brasil/

[58] https://indonesiabusinesspost.com/2229/business-and-investment/kominfo-unveils-plans-for-satria-2-satellite-through-foreign-investment

PT Telkomsat, PT PSN, and PT BRI, while BRIN is the sole local operator of NGSO constellations in Indonesia.

The regulations in Indonesia facilitate the use of local and foreign satellites to provide services in Indonesia. Currently, 47 foreign satellites are authorized to provide services in Indonesia. Among those authorized foreign satellites are NGSOs, such as Starlink, Oneweb, and O3B satellites.

At the same time, established local players have been upgrading and expanding satellite capacity. PT Telkomsat launched a new high-throughput satellite, Telkomsat-HTS 113BT (MERAH PUTIH 2), in February 2024 to increase national capacity. This satellite added significant capacity, ensuring continuity of service for broadcasters and VSAT users. PT PSN has been operating the Nusantara series satellites (e.g., Nusantara Satu at 146°E) and launched SATRIA-1, a large Ka-band satellite to support government connectivity needs.

Overall, the market is experiencing increased private sector involvement and foreign partnerships, which are expanding the variety of services available while prompting incumbents to upgrade their infrastructure.

Regulatory framework and evolution

Institutional framework

In 2025, Indonesia undertook significant institutional restructuring to enhance governance in its digital sector, aiming to streamline digital transformation and improve public services.

Indonesia's satellite telecommunications sector is currently overseen by Komdigi. Komdigi combines policy-making and regulatory functions, setting policies, allocating frequencies/orbital resources, and issuing licences for telecommunication and satellite operations.

Komdigi comprises five directorate general: 1) Directorate General of Digital Infrastructure (DJID)[59] that handles infrastructure strategy, spectrum management, digital infrastructure services, and disaster management; 2) Directorate General of Government Digital Technology (DJTP), manages e-Government systems, public electronic system registration, and ICT audits; 3) Director General of Digital Ecosystem (DJED), oversees licensing for postal, broadcasting, and private electronic systems, AI and new technology ecosystems; 4) Directorate General of Digital Space Oversight (DJPRD), handles digital oversight, electronic transactions, and private electronic systems monitoring, including personal data protection; 5) Directorate General of Public Communication and Media (DJKPM), manages public information services, media ecosystem development, and crisis communication. Furthermore, Komdigi also has a single body that manages the universal service obligation (USO) fund and provides telecommunication infrastructure in underserved and unserved areas, namely BAKTI.

The directorate with jurisdiction to formulate regulations regarding spectrum planning and satellite orbit management in Komdigi is the Directorate of Spectrum Planning, Satellite Orbit Management, and Digital Infrastructure Standardization under the Directorate General of Digital Infrastructure (DJID). On the other hand, BAKTI may initiate and manage government satellite programmes to provide services in unserved and underserved areas by utilizing the USO fund

[59] Formerly "Directorate General of Posts and Information Technology" (SDPPI).

and public-private partnerships. BAKTI may define connectivity targets (such as schools and health clinics) and procure the services, while DJID issues the operational permit to service providers, including frequency assignments and landing rights, and evaluates and monitors frequency utilization.

Legal and regulatory structure

The foundation of the legal framework for satellite communications is the Telecommunications Law No. 36/1999 (amended by the Omnibus Law No. 11/2020), which establishes licensing and use of radio spectrum and/or orbit procedures, alongside detailed regulations specific to satellite operations. In 2021, a reform established the Government Regulation No. 5/2021, which revamped the telecommunication licensing regime to simplify bureaucracy and encourage investment in Risk-Based Business Licensing. Under this framework, satellite communication services (considered high-impact) still require thorough licensing, but procedures were streamlined and foreign ownership restrictions relaxed in line with the new investment policies. However, in 2025, the regulation was replaced by Government Regulation No. 28/2025, which brings several important changes to risk-based business licensing, focusing on increasing legal certainty, process efficiency, and the application of digital technology.

Recently, Komdigi also commenced implementation of the Ministerial Regulation No. 3/2025 regarding the utilization of satellite spectrum and the management of orbits. This new framework aims to foster a more robust investment climate and accelerate the adoption of cutting-edge satellite technologies. Among the key highlights of this regulation are simplified licensing procedures to reduce regulatory barriers, enhanced procedures to increase the supply of national satellite capacity through the utilization of Indonesian and foreign satellites, and provides guidelines for emerging satellite technologies, such as non-GSO satellite systems and earth stations in motion (which also includes earth station utilization in vessels and aircraft). The regulation also facilitates collaboration between local satellite industries with global players through satellite filing management, satellite deployment partnerships, and lifetime and wholesale satellite capacity leasing. The regulation enhances procedures to ensure sovereignty and data security within Indonesian territory by requiring infrastructure in Indonesia to monitor local traffic, access to information, and user terminals. This procedure could enhance government oversight and control mechanisms.

Another regulation that could be referred to in terms of providing satellite services in Indonesia is the Ministerial Regulation No. 12/2022 regarding the Indonesian Table of Frequency Allocations, which aligns with the ITU Radio Regulations and supports the flexible use of satellite spectrum.

According to Ministerial Regulation No. 3/2025, operators must obtain a telecommunication network licence from Komdigi to provide satellite-based services. In cases where foreign satellites are used to provide services in Indonesia, the foreign operator shall partner with local operators. Furthermore, the utilization of foreign satellites in Indonesia also requires having landing rights and frequency usage licences prior to providing service in Indonesia. Before obtaining any landing rights and license, the foreign satellite must also be included in the list of foreign satellites eligible to provide services in Indonesia[60]. The foreign operator may submit the application to be listed to Komdigi and enter the evaluation process.

[60] Operators may submit the landing right application through the Online Single Submission (OSS) system once their foreign satellites are listed in the eligibility list.

The Ministerial Regulation No. 3/2025 also regulates the milestones that satellite operators must comply with in the satellite lifecycle[61].

Indonesia maintains a policy that favours the use of national satellites, while also allowing foreign satellites to provide services in Indonesia. Currently, Indonesia allows up to 100 per cent foreign ownership in telecommunication service companies (including satellite ISPs), enabling foreign players to establish a local entity and operate independently[62].

Market access evolution

In response to the rapid evolution of technology, Komdigi has updated its regulations on spectrum and satellite use, aligning with global trends in satellite technology. Several polices and regulations to attract global satellite players providing services in Indonesia, such as:

- The updated fee structures for satellite spectrum use as regulated in Government Regulation No. 43/2023 and Ministerial Regulation No. 9/2023. Both regulations aim to make licensing costs proportional to coverage, capacity, and the use of satellite technology.
- The updated regulation regarding the utilization of satellite spectrum and the management of orbits, Ministerial Regulation No. 3/2025. This aims to foster a more robust investment climate and accelerate the adoption of cutting-edge satellite technologies. The regulation also encourages collaboration between local satellite industries with global players through satellite filing management, satellite deployment partnerships, and lifetime and wholesale satellite capacity leasing. Lastly, the regulation enhances procedures to ensure sovereignty and data security within Indonesian territory by having infrastructures within Indonesia's area that can monitor local traffic, user terminals, and perform functions for law enforcement purposes. This ensures that Indonesian authorities can monitor traffic for compliance with laws (such as content filtering and lawful intercept) and for guaranteeing customer service standards.

Public policy and universal access initiatives

Government initiatives for connectivity

Komdigi, through BAKTI, has launched specific initiatives to connect public facilities in the underserved and unserved areas – including healthcare centres, schools, and village offices – via satellite Internet . A flagship satellite programme, called SATRIA-1 (Satelit Republik Indonesia Raya) was designed to provide free or subsidized Internet access to 37 500[63] public service points across the country, with a focus on the 3T regions (T*erdepan, Terluar, Tertinggal*).

The price of satellite capacity for SATRIA-1 is USD 52 per Mbit/s, a significant reduction compared to the USD 200-400 range typical for similar high-throughput satellite (HTS) satellites. The implementation of SATRIA-1 is a substantial step toward bridging the digital divide in areas where terrestrial fibre or mobile networks are not available, ensuring that remote and underserved regions have access to Internet services, which are essential for education, government services, and economic development.

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61 Specifically in terms of ITU satellite filing milestones, satellite launch, satellite deployment, and satellite de-orbit.
62 Presidential Regulation No. 49 of 2021 regarding Amendment to Presidential Regulation Number 10 of 2021 concerning Investment Business Sectors.
63 Information provided through a questionnaire addressed by Indonesian authorities.

According to data published by BAKTI in May 2025, the capacity utilization of SATRIA-1 has reached 74 per cent, connecting 27 805 sites. The highest utilization is on Sumatra Island, which accounts for 26.85 per cent. SATRIA-1 also benefits 19 598 schools, 5 827 government offices, and 1 362 healthcare centres.

In May 2024, Indonesia's Ministry of Health launched an initiative utilizing non-geostationary LEO satellite technology. The Ministry partnered with Starlink to pilot satellite broadband in remote health centres. The service was inaugurated at three clinics–two in Bali and one on Aru Island in Maluku, one of Indonesia's outermost regions. This pilot programme provides high-speed Internet to clinics that previously had minimal connectivity, allowing for services such as teleconsultations and quick access to medical information. The goal of this project is to extend reliable Internet connectivity to all remote health centres in Indonesia's outer regions.

Both the Ministry of Health and SATRIA-1 demonstrate how the Government of Indonesia can effectively bridge connectivity gaps for essential services by collaborating with the private sector through public-private partnerships. This approach enables large-scale government projects to deliver public goods and services, focusing on immediate solutions for high-priority locations (such as hospitals on remote islands) while awaiting the implementation of more extensive infrastructure.

Indonesia has also been working to bridge the digital divide with two other initiatives, called the Desa Internet (Internet Villages) programme (2014) and the Gerakan Nasional 1000 BTS (National Movement for 1000 Mobile Base Stations) project (2017). The former focuses on setting up telecentres (community-based Internet hubs) in villages, enabling local populations to gain access to digital resources for education, business, healthcare, and government services. At the same time, the latter aims to improve mobile network coverage across Indonesia, especially in remote and hard-to-reach areas, by establishing mobile base stations (BTS) in remote areas.

The government's digital infrastructure expansion aligns with the 2020-2024 National Medium-Term Development Plan (RENSTRA). The current strategy is holistic, utilizes fibre optic cables where possible (e.g., the Palapa Ring project for backbone connectivity), and deploys satellites where only sky-based connectivity is available. As of now, 7 015 schools have been connected through satellite services, representing a penetration rate of 47 per cent among the 92 000 schools that require Internet access. Similarly, 2 616 health facilities have been connected through satellite services, covering approximately 13 per cent of healthcare centre needs.

These schools and health facilities were connected by a combination of Indonesian satellites operating before and during the implementation of the 2020-2024 Government Strategic Plan, including PSN satellites, Telkom Group satellites, and SATRIA-1.

Public-private partnerships

Public-private partnerships (PPPs) have been a key mechanism for Indonesia to finance and execute its ambitious satellite connectivity goals. The Indonesia Multifunctional Satellite PPP Project (the programme behind SATRIA-1) is a landmark example. Under this PPP, a consortium led by private operator PT PSN was awarded the contract to build, launch, and operate the SATRIA-1 satellite, with the government as the anchor customer for its capacity. This model allowed Indonesia to tap into private sector expertise and funding while ensuring the satellite's capacity is dedicated to public use. International financing institutions, such as the Asian Infrastructure Investment Bank (AIIB), also supported the project, with AIIB approving

USD 150 million in financing for SATRIA-1, marking its first investment in a satellite-based infrastructure project.

The PPP structure of SATRIA-1 includes the satellite manufacturer (Thales Alenia Space) and the launch provider (SpaceX) as subcontractors to the PSN-led consortium, along with a long-term concession agreement. Under this agreement, the consortium will provide a specified bandwidth capacity (150 Gbit/s) exclusively for government-designated sites over 15 years.

Financial support structure

The expansion of satellite-based digital infrastructure in Indonesia relies on a blended finance model, incorporating various funding sources to ensure sustainability and effectiveness. One of the policy instruments used by the government to ensure equal access to telecommunications and Internet services for all citizens is the USO fund. The USO, considered a PNBP (State non-tax revenue), is primarily funded through contributions from telecommunications operators, which are required to allocate 1.25 per cent of their gross revenue. Besides the USO contribution, operators also pay 0.5 per cent of their revenue to the "Telecommunications Implementation Cost" (BHP), which is paid annually as a PNBP. The Indonesian government, through BAKTI, manages these funds and directs them toward infrastructure projects, including the deployment of satellite technology.

Other sources are government budgets and village funds. The government budgets include funds allocated for KOMDIGI and BAKTI for special government programmes, i.e. for digital inclusion projects, and development partnerships with international organizations or private-sector stakeholders.

BUMDes (*Badan Usaha Milik Desa* – BUMDes) are village-owned enterprises, economic entities established and managed by village governments to drive local economic growth and improve community welfare. The BUMDes manages independent village funds provided by the government, as well as by the local community. Collaboration with BUMDes is expected to provide funding for additional equipment or operations that are needed, in particular for the ground segment.

The provision of services through satellite technology is also carried out directly by some ministries or agencies that have their resources or budgets. In some cases, they lease domestic or foreign satellite capacity to provide infrastructure, thereby reducing their reliance on BAKTI.

Currently, almost 99 per cent[64] of the terminal devices distributed by the government to service points are provided free of charge, but the expectation is to develop a more sustainable model in the future.

Key findings

In summary, Indonesia's experience demonstrates several successful approaches to leveraging satellite technologies for public connectivity:

- **Strategic infrastructure investment**: Indonesia has made significant investments in satellite capacity through the SATRIA-1 project, ensuring dedicated capacity for government connectivity needs across remote archipelagic regions. This government-led

[64] VSAT (Very Small Aperture Terminal) units that provide satellite internet connectivity to service points.

initiative focuses particularly on underserved areas where terrestrial infrastructure is not economically viable.

- **Effective public-private partnership models**: Indonesia's implementation of the SATRIA-1 project, led by a consortium including PT PSN, demonstrates how PPPs can leverage private sector expertise and funding while ensuring dedicated capacity for public services. The 15-year concession agreement provides long-term stability for both government and private partners.
- **Regulatory openness to new technologies**: Indonesia's regulatory framework has adapted to support the provision of satellite services using both domestic and foreign satellites. This has fostered partnerships between global satellite companies and local industries. Additionally, the licensing processes have been updated to align with technological advancements while upholding national sovereignty requirements. This balanced approach has attracted international players while ensuring compliance with local policies.
- **Integrated connectivity strategy**: Indonesia integrates satellite technology as part of a broader connectivity approach, utilizing satellites strategically where they offer the best solution, which could provide connectivity in areas that cannot be feasibly provided by terrestrial services, while complementing terrestrial fibre backbone projects, such as Palapa Ring. This coordinated approach enables more effective use of resources.

Challenges

Several challenges persist in Indonesia's satellite connectivity landscape:

- **Indonesia’s archipelagic geography challenge:** presents unique challenges for the implementation of satellite services. Each region requires tailored service configurations, while uneven electricity distribution across the country limits the effectiveness of satellite terminals in many remote areas. In addition, the geographical barriers impose significant challenges for the logistics and distribution of satellite equipment to hard-to-reach regions.
- **Administrative capacity and digital literacy**: small villages often lack the necessary administrative capacity and digital literacy to sustain satellite services, posing sustainability challenges for government-initiated connectivity projects.
- **Balancing digital sovereignty with technological advancement**: Indonesia must continue to navigate the complex balance between protecting national digital sovereignty (through requirements such as the local network operation centres) while remaining attractive to international satellite operators who bring advanced technologies.
- **Sustainable financing models**: While the government currently provides free equipment to most service points, developing more sustainable financial models remains a challenge for the long-term viability of satellite connectivity programmes.
- **Technical capacity development**: Building local technical expertise to maintain, operate, and eventually develop satellite infrastructure represents an ongoing challenge for Indonesia's satellite ambitions, especially as it looks toward more advanced satellite technologies, such as LEO satellite constellations, multi-orbit satellite systems, and non-terrestrial networks.
- **The risk of technology obsolescence:** particularly in the case of government managing its own GSO satellite projects with a lifespan of at least 15 years, presents a significant challenge in adapting to emerging satellite technology trends that may offer superior quality and higher capacity.

2.3. Kenya

Market overview and development

Market structure

Kenya's Internet market is dominated by terrestrial providers, but satellite services have recently emerged as a small yet growing segment. The overall fixed data market in Kenya is led by fibre and mobile network operators (e.g. Safaricom, Jamii Telecommunications, Wananchi Group), which account for the vast majority of the 1.5+ million fixed Internet subscriptions. These users were served by international satellite operators (such as Intelsat, SES, Eutelsat, and Avanti) through local ISPs and resellers. Local companies such as CommCarrier and iWayAfrica have operated VSAT networks in Kenya, delivering satellite connectivity to businesses, government agencies, and some community projects using capacity leased from those global GEO satellites.

Currently, mobile broadband coverage reaches 98 per cent of the population, and the country accounts for over 45,000 km of fibre optic networks, with an ambitious target of 100,000 km by 2027. 4G mobile networks cover 97 percent of the population, with 2G and 3G networks reaching 98 percent[65]. 5G services are now accessible in all 47 counties, marking a major milestone in connectivity[66].

SpaceX's Starlink entry in the Kenyan market has significantly changed the share of satellite broadband market with its low-Earth orbit (LEO) service, disrupting the market dominance of established providers. Before 2023, the total number of satellite Internet subscriptions in Kenya was extremely low (only about 405 users as of mid-2023). Starlink began operations in Kenya in mid-2023, instantly adding thousands of new satellite Internet users[67].

Additionally, new satellite entrants beyond Starlink are on the horizon. OneWeb, another LEO constellation, has signaled interest in the Kenyan market: the Kenya Education Network (KENET)[68] began piloting OneWeb terminals in 2024 to connect remote university campuses.

In summary, Kenya's satellite Internet market structure now includes one major LEO broadband provider (Starlink) alongside a few GEO-based providers serving specialized needs, whereas previously it was served only by small-scale VSAT operators with minimal market presence.

Market share dynamics

Starlink's expansion in the country has led to a 152.8 per cent surge in utilized satellite Internet capacity. By September 2024, Starlink had become the dominant player in the country's satellite

65 https://x.com/CA_Kenya/status/1806017194641252638/photo/1, 4G dominates Kenya's mobile data usage - Capital Business

66 Safaricom claims 5G coverage lead in Kenya | Network & Infrastructure | TelcoTitans.com

67 The Communications Authority of Kenya (CA) report attributes a 104.7% rise in satellite internet subscriptions due to Starlink's customer acquisition campaign, which introduced a rental option for satellite equipment at a reduced cost. The rising demand for Starlink's services led the company to temporarily halt new subscriptions in Nairobi and its surrounding regions due to network capacity overload.

68 Kenya's National Research and Education Network (NREN), established to enhance the use of Information and Communication Technology (ICT) in the country's education and research sectors. It is a not-for-profit organization licensed by the Communications Authority of Kenya (CA) that provides cost-effective, high-speed internet connectivity and related services to educational and research institutions across Kenya.

segment – 16,786 out of Kenya's 17,042 total satellite Internet subscriptions were on Starlink (over 98 per cent)[69].

In terms of the broader fixed Internet market, Starlink's subscriber base (roughly 16–17k users) gave it about 1.1 per cent market share of all fixed data subscriptions, surpassing Liquid Telecommunications Kenya and Vijiji Connect.

Table 2: Starlink is the 8th largest Internet service provider by subscriptions in Kenya (CA)

Service Provider / Indicator	Number of data subscriptions	Percentage market share (per cent)
Safaricom PLC	575,835	36.6
Jami Telecommunications Ltd	384,616	24.4
Wananchi Group (Kenya) Ltd*	265,194	16.8
Poa Internet Kenya Ltd	198,690	12.6
Mawingu Networks Ltd	44,311	2.8
Viuson Network Limited	27,734	1.8
Dimension Data Solutions East Africa Ltd	17,844	1.1
Starlink Internet Services Kenya	16,786	1.1
Liquid Telecommunications Kenya	15,851	1.0
Vijuji Connect Ltd	9,816	0.6
Other Fixed Service Providers	18,227	1.2

Despite Starlink's rapid growth, Safaricom remains the dominant player with over 575,000 subscribers and a 36.6 per cent market share, followed by Jamii Telecommunications at 24.4 per cent and Wananchi Group at 16.8 per cent. Other providers include Poa Internet, with 198,609 subscribers (12.6 per cent market share), and Mawingu Networks, with 44,311 subscribers (2.8 per cent market share).

Recent developments

The launch of Starlink's LEO broadband service in Kenya (officially in July 2023) marked the first time a high-speed, low-latency satellite Internet option became available to the general population. This new addition to the market brought price reductions in 2024, making prices and performance competitive with terrestrial options. In April, the company offered a 30-day window, slashing installation kit prices from KES 89 000 to KES 45 000, and also lowered onboarding costs to attract customers. Starlink offers fibre-like broadband speeds (50–200 Mbit/s) and much lower latency.

These incentives spurred competition, prompting other ISPs to introduce promotions such as increased Internet speeds and price reductions. Also, to strengthen its infrastructure, Starlink

69 Data reference from July to September 2024.

has established a ground facility in Nairobi to improve network performance. The new "point of presence" is expected to reduce latency from approximately 120 milliseconds to below 30 milliseconds. Additionally, the firm is planning to introduce direct-to-device Internet services, eliminating the need for traditional hardware kits and associated costs.

Safaricom, the country's largest telco, launched new 5G fixed-wireless access (FWA) broadband offerings in 2023–24 to compete in areas that Starlink might target, and invested in expanding its fibre network and even international bandwidth (via new subsea cables) to underscore its capacity advantages.

The overwhelming majority of Kenya's satellite bandwidth consumption is now carried via NGSO constellations, whereas GEO satellites have largely been relegated to backup and niche roles in the market. This marks a pivotal development: Kenya is one of the early African markets to see LEO satellite Internet gain significant traction, illustrating a shift in the technology mix of its connectivity landscape.

Regulatory framework and evolution

Institutional framework

The Ministry of Information, Communications and Technology (ICT) is the lead government ministry setting national policy for ICT development, including broadband and universal access goals. Under the Ministry, the Communications Authority of Kenya (CA) is the independent regulator responsible for telecommunications and radiocommunication services. The CA oversees licensing, spectrum management, and enforcement for all telecommunication operators, including mobile networks, ISPs, and satellite service providers. In practice, any company offering satellite communication services in Kenya must be authorized by the CA under the existing telecommunication licensing regime. The CA also administers Kenya's Universal Service Fund (USF) to finance connectivity in underserved areas.

Kenya has also established, in 2017, a dedicated agency for space matters – the Kenya Space Agency (KSA), that is mandated to promote, coordinate and regulate space-related activities in the country. It oversees issues such as satellite development, space science, and international coordination of orbital resources. The KSA operates under the Department of Defence, and it works alongside the CA when it comes to communications satellites, handling matters such as securing orbital slots, liaising with the International Telecommunication Union (ITU) on Kenya's satellite filings, and developing space policy. Meanwhile, the CA regulates the ground segment and service provision (spectrum licensing, gateway stations, end-user services).

For coordination, a National Space Committee and inter-agency consultations align the ICT ministry, CA, KSA, and other stakeholders on satellite initiatives. The CA handles the licensing of user terminals and landing rights, while KSA provides advisory input on space policy implications. Additionally, the Kenya Civil Aviation Authority (KCAA) may also be consulted for high-altitude radio equipment (primarily for HAPS/balloons rather than satellites).

Legal and regulatory structure

Kenya's regulatory regime for satellite communications operates within a unified licensing framework, which means that the country's telecommunications regime is organized around technology-neutral licence categories, and Kenya issues licences based on broad service categories rather than requiring separate licences for each specific service or technology.

Satellite operators generally require the Network Facilities Provider category[70] (with tier based on coverage), the Landing Rights License[71], and, if applicable, VSAT or county-level licences.

The NFP licence for satellite operators is divided into several tiers based on the scope of operation: 1) NFP-Tier 2, for providers operating satellite services within Kenya; 2) NFP Tier-3, for those establishing satellite hubs and infrastructure serving up to three countries; 3) NFP-Tier 4, for operations limited to a single county, and requires a simultaneous County ASP license.

The Satellite Landing Rights license, which is mandatory for foreign satellite operators, permits an operator to downlink satellite signals into Kenya. To offer services to end users in Kenya (homes or businesses), foreign satellite operators must enter into an agreement with a locally licensed Application Service Provider (ASP)[72].

Operators wishing to install and operate private VSAT terminals or satellite news gathering equipment must apply for specific VSAT licences, with detailed technical and compliance requirements. A separate licence is also required to deploy gateways. The CA also requires compliance with Kenyan type-approval for satellite equipment (to ensure that devices meet safety and interference standards).

Table 3: Summary of licensing requirements for satellite operators in Kenya

Licence type	Scope	Key requirements/fees
NFP (Tier 2/3/4)	Infrastructure (national/ multi-county/single-county)	Application, local registration, technical compliance, annual fee (0.4 per cent turnover)
Satellite Landing Rights (SLR)/Landing Rights License (LRL)	Signal delivery into Kenya	One-off licence fee (proposed amount is KES 16.22 million, USD 125 493.23 as of June 2025), annual fee, compliance with CA regulations
VSAT/Private Earth Station	Private satellite terminal operation	Specific application, compliance with technical standards
County ASP License (if NFP-T4)	Singe county operations	Additional application and fees

70 The Unified Licensing Framework (ULF) comprises three primary licence categories: 1) Network Facilities Provider, for network infrastructure providers; 2) Application Service Provider (ASP) to offer application services to end-users; 3) Content Service Provider (CSP) for offering content services over electronic communication networks for a specified term, although they do not operate their own network infrastructure (this type of licence is relevant for satellite television operators or broadcasters).

71 The fee for this has been a one-time payment of KES 1.78 million (USD 13 771.76 as of June 2025) for a 15-year term, although the Communications Authority (CA) proposed to increase it to KES 16.22 million (USD 125 493.23 as of June 2025).

72 According to the application for satellite landing rights authorization currently in force. Available at: https://www.ca.go.ke/sites/default/files/articles/Telecoms%20Forms/Application-for-Satellite-Landing-Rights-TL-5.4.pdf.

Market access evolution

The surge of NGSO services prompted Kenya to begin updating its satellite regulations in 2023–2024. Kenya previously required that companies providing ICT services, including satellite communications, had at least 30 per cent substantive Kenyan ownership. This rule changed in 2023, and now permits fully foreign ownership for satellite companies providing services in the county. The shift aims at making Kenya a more attractive digital investment hub, following the Kenya Vision 2030, a long-term development document that brings the goal for Kenya to be a globally competitive knowledge-based economy by the year 2030. One of the government strategies to achieve the vision includes the development and promotion of the ICT sector to spur investments and create employment for Kenyans. The current regulatory focus is on licensing, compliance, and technical standards.

Recently, the CA announced plans to introduce new licensing fees for satellite Internet service providers (ISPs). The proposal for the 15-year licence is to increase it from approximately KES 1.78 million (USD 13 771.76 as of June 2025) to KES 16.22 million (USD 125 493.23[73] as of 3 June 2025). The CA also suggested introducing an annual operating fee (or revenue share) for satellite ISPs of 0.4 per cent of gross annual revenue with a minimum payment of KES 4 million per year (USD 30 947.78 as of June 2025), which significantly raises operational costs. These regulatory changes could also pose financial challenges, particularly for smaller market players, potentially leading to increased costs for consumers. Under the new proposed guidelines, satellite providers could operate terrestrial cables, telemetry systems, tracking facilities and even participate in space research, which would significantly improve latency issues and support future service enhancements. The proposed adjustments are previewed in the Review of Telecommunications Market Structure 2024. As of early 2025, these proposals were under review and had not yet been fully implemented.

Kenya is also updating its space policy and laws. A draft of Kenya Space Bill 2024 was recently sent to the Office of the Attorney General for review, and it will likely be presented to the National Assembly for consideration after the review is completed. The bill formally establishes the mandate of the Kenya Space Agency and outlines regulations for space activities, covering areas such as authorization of satellite launches, registration of Kenyan space objects, and management of orbital debris – aligning Kenya's laws with international space treaties.

The Kenya Space Bill, 2024, explicitly allows foreign entities to provide commercial satellite communication services in Kenya, provided they: 1) Register as a corporate entity in their home country; 2) Obtain all necessary approvals from Kenyan communications authorities; 3) Submit technical and operational information about their satellite systems; 4) Provide International Telecommunication Union filings and licences from their home country regulator

In summary, Kenya's regulatory framework for satellites is in a state of evolution. Existing telecommunication laws have been applied to new LEO services, and now regulators are refining the regime to ensure the rules keep pace with the changing market.

Ongoing debates

SpaceX's Starlink started its operations in the country in July 2023 and has experienced rapid growth since. Offering affordable, high-speed satellite Internet, the service has gained

73 An application fee of KES 5 000 would also be charged.

over 8,500 users in just over a year. Starlink was granted a temporary licence to operate independently[74], which has become a point of contention with local telecommunication giant Safaricom[75].

Safaricom has requested the CA to consider requiring satellite Internet providers, such as Starlink, to partner with local operators[76]. Safaricom has directly written to the Communications Authority of Kenya's director-general to express concerns about the granting of independent licences to satellite Internet providers. It called on the Communications Authority to consider requiring satellite providers to operate as "infrastructure providers" to mobile network operators such as Safaricom. It said this would ensure providers invest in Kenya, employ local people and comply with Kenya laws. Additionally, Safaricom warned that the current regulatory gaps could lead to illegal connections and security risks, particularly with the lack of oversight on cross-border satellite services.

While the regulatory framework is still under development, the CA emphasised that the response to Starlink's operations will be shaped by ITU's global guidelines and has also asked ITU for regulatory guidance. The CA stated that they are in the process of developing the regulatory framework to ensure fair competition and quality of service for all industry players.

Another topic related to this debate centres on competition and consumer protection: the Competition Authority of Kenya has been drawn into discussions after legal action by a Kenyan advocacy group sought to ensure Starlink's access is not unfairly blocked by competitors.

Regulatory sandboxes

Recognizing the need for agile regulatory frameworks to support the safe development and deployment of emerging technologies, the Communications Authority of Kenya (CA) has established the Framework for Emerging Technologies Regulatory Sandbox. This initiative offers a controlled environment where innovators, start-ups, and tech enterprises can test their solutions under relaxed regulatory conditions while maintaining close supervision and collaboration with the regulator. And to further catalyse innovation, the Communications Authority established the Global Innovation and Entrepreneurship Centre (GIEC)–an acceleration and support hub that complements the sandbox ecosystem.

Public policy and universal access initiatives

The Kenyan government recognizes satellite technology as a crucial tool for achieving universal Internet access, especially in remote and underserved areas where terrestrial infrastructure is lacking.

The 2023/24 Kenya Housing Survey[77] highlights persistent disparities in access to digital technologies across the country. Nationally, only 35 per cent of the population used the Internet in the three months preceding the survey, with urban areas (56.5 per cent) significantly outpacing rural areas (25 per cent). Internet usage varied greatly by county, with Nairobi City

[74] Without an agreement with a local application services provider. See also: https://eastleighvoice.co.ke/starlink/90639/kenya-now-turns-to-un-telecommunications-agency-to-regulate-starlink

[75] Safaricom is partly government-owned.

[76] This happened after Starlink introduced competitive prices options and plans that allowed Kenyans to rent its equipment without having to purchase the whole package.

[77] 2023/24 Kenya Housing Survey

(64.7 per cent) and Kiambu (54 per cent) leading, while West Pokot recorded the lowest rate (9.1 per cent). Only 36.3 per cent of households had Internet access (either mobile or fixed).

Kenya's Digital Superhighway initiative is a transformative project aimed at enhancing the nation's digital infrastructure to foster economic growth, job creation, and improved public service delivery. It focuses on expanding the fibre optic network, connecting over 74 000 public institutions, including schools, hospitals, and government offices, to the Internet, deploying 25 000 public wi-fi hotspots, setting up 1 450 digital hubs, and digitizing 80 per cent of government services.

Meanwhile, Kenya's National Broadband Strategy (NBS) outlines an ambitious plan to achieve 100 per cent Internet connectivity for all schools at a minimum speed of 10 Mbit/s by 2030. This initiative aims to integrate digital learning into the education system, ensuring students and teachers have access to online resources and tools. In order to achieve this target, Kenya has established collaborations with international agencies, such as UNICEF and ITU, with the Giga initiative and has also aimed at public-private partnerships with companies such as Nokia and Safaricom. The Giga project received USD 140 million to be invested in connecting 1 000 public primary schools. It will use a mix of solutions, including extending fibre to schools within reach, installing wireless (4G/5G or microwave) links, and deploying satellite connectivity for the most isolated schools.

In 2022, Kenya's largest operator, Safaricom, entered a multi-year agreement with Intelsat to use satellite connectivity for expanding 4G/LTE coverage in rural Kenya. Under this partnership, Intelsat supplies satellite backhaul links to Safaricom, enabling the mobile operator to roll out cellular base stations in communities that are too remote for fibre or microwave backhaul. In 2024, KENET (Kenya's academic network) forged a partnership with SpaceX Starlink to connect higher-education campuses in remote areas. KENET equipped 15 university campuses with Starlink terminals on a trial basis, greatly improving their bandwidth availability and is also planning to deploy OneWeb LEO services.

Similar approaches are being applied to healthcare: several pilot programmes from Global Telehealth Network (GTN)[78], are helping to develop the establishment of telemedicine. For instance, Sekenani Health Centre, located in the Maasai Mara National Reserve has equipment for a telehealth connection, although they still need an improved solar power to utilize this connection. With upgraded infrastructure, the health workers at clinics with GTN pilot projects will be able to benefit from the connectivity the project provides.

The Communications Authority (CA) in Kenya employs a comprehensive methodology to determine deployment sites and technology selection for connectivity projects. The ICT Access Gap Study maps underserved and unserved areas by analysing population density, distribution of schools and hospitals, and existing telecommunication coverage data to identify connectivity gaps. The Authority utilizes GIS tools and terrain analysis to assess distances from existing National Optic Fibre Backbone Infrastructure (NOFBI), evaluate topographical challenges, and estimate cost-per-kilometre for deployment. Additionally, they conduct market studies that engage all telecommunication operators to gather data on required fibre routes, while commercially viable routes receive implementation priority to ensure project sustainability by the government. Public service facilities are prioritized based on population served, critical

[78] Non-profit organization (https://www.globaltelenet.org/mission-scope-of-work-1?utm_source=chatgpt.com).

service delivery roles, and strategic importance of flagship facilities such as major hospitals, schools, and border points.

The technology selection follows specific criteria: institutions located more than 20 kilometres from existing backbone infrastructure are designated for satellite connectivity, sites with prohibitively high fibre deployment costs are considered for satellite solutions, and areas with challenging terrain or security concerns in remote locations are also earmarked for satellite technology. This systematic approach supports Kenya's digital masterplan to deploy 100 000 kilometres of fibre optic cables across all 47 counties, connect 25 000 public Wi-Fi hotspots, and link 74 000 government institutions to the One Government Network, ensuring optimal resource allocation and comprehensive national connectivity coverage.

Table 4: Minimum connectivity parameters (Communications Authority of Kenya)

Facility type	Current "*baseline*" requirement used in contracts	Parameters for Satellite Technology[79]
Primary and junior-secondary schools	5 Mbit/s download speed / 1 Mbit/s upload speed per site under the CAK Education Broadband/USF roll-outs (2019-24)	VSAT lots funded by USF: minimum 5 Mbit/s download speed, 95 per cent monthly availability, ≤ 750 ms round-trip time (RTT). New LEO trials (Starlink/OneWeb) are being evaluated at ≥ 50 Mbit/s download speed, < 60 ms RTT
Level 2-3 dispensaries and health centres	10 Mbit/s symmetrical[80] download speed i for EMR[81] + basic telemedicine services (Digital Health Regulations draft, 2024[82])	Remote arid counties are earmarked for **hybrid LEO+4G** packages; the QoS target is aligned to the public facility profile (≥ 50 Mbit/s download speed ↓, 20-40 ms latency when LEO is used).
Level 4 county hospitals and referral facilities	50 Mbit/s download speed / 50 Mbit/s upload speed symmetric connectivity (NOFBI[83] or carrier-class microwave) in existing fibre SLAs	LEO is considered only for back-up; must meet primary link's 99.5 per cent availability and < 100 ms jitter requirement for real-time surgery mentoring.

Kenya's connectivity targets and parameters are established through a three-tier framework combining policy anchors, demand modelling, and technical specifications. The National Broadband Strategy (2018-2023) and Digital Master Plan (2022-2032) set baseline requirements of 10 Mbit/s per school and fibre connectivity to counties, escalating to 100 Mbit/s for high-demand health facilities and gigabit speeds for flagship schools. There are also minimum bandwidth standards for electronic medical records and telemedicine applications, as agreed in collaboration between the MOH and the ICTA.

Network design parameters establish strict quality of service standards with latency under 50ms for fibre/4G/5G networks, while GEO satellite connections allow up to 750 ms and LEO satellites must maintain under 60ms. Availability requirements vary by facility type: 95 per cent for schools,

79 Sites that cannot be covered with fibre optic technology.
80 At least 10 Mbit/s per second for both downloading and uploading data.
81 Electronic Medical Records system.
82 The minimum standards were reached in collaboration between the MOH (Ministry of Health) and the ICTA (Information and Communication Technology Authority), in SLAs (Service Level Agreements).
83 National Optical Fibre Backbone Infrastructure.

98 per cent for health centres, and 99.5 per cent for hospitals, with packet loss capped at 1 per cent and jitter under 30ms. Satellite-specific targets differentiate between legacy GEO VSAT systems providing 5 Mbit/s download speeds with 95 per cent uptime, and newer LEO pilots offering 50-150 Mbit/s downloads with 99 per cent uptime and significantly lower latency.

Regarding satellite use for achieving these goals, the government focuses on Kenya Space Agency's Strategic Plan 2020-2025, that promotes, coordinates and regulates space-related activities to enhance utilization of space technology for socio-economic development.

According to the Kenya Government[84], a total of 4 618 sites have been connected country wide, through the connectivity projects. Besides that, a total of 53 000 sites have been identified for connectivity. Currently, 5 568 sites are in the process of being connected under the Digital Superhighway project. None of these sites have yet been connected utilising satellite technology.

Public policy discussions also include training local technicians (to maintain VSAT equipment), and leveraging solar power for terminals to reduce operational costs in off-grid locations.

Financial support structure

The government combines public funds, targeted subsidies, and public-private partnerships (PPPs). The main source for funding public initiatives is the universal service fund (USF) managed by the Communications Authority of Kenya. The USF is specifically designed to support the expansion of communication services to areas deemed commercially unviable by private sector operators. These funds are allocated through competitive projects and grants to enhance infrastructure and digital access, which could include satellite-based solutions for hard-to-reach regions.

The main idea is to establish ongoing subsidies where the government pays a portion of the monthly service fee for each site, while local entities pay the rest or find funds to continue the service. This cost-sharing can make satellite Internet affordable for schools or clinics that have limited budgets. In many cases, initial donations or USF funding covers 1-2 years of connectivity.

Kenya is also exploring models such as subsidized bulk bandwidth purchases (in which the government contracts satellite bandwidth in bulk and allocates it to schools/clinics), or models that integrate satellite connectivity costs into recurrent budgets of the education and health ministries. Leasing capacity from commercial satellites is also an option, where Kenya does not invest in its own communications satellites. This avoids large upfront costs, but it means recurring leasing fees.

Additionally, partnerships with local universities (through KENET) are building expertise in satellite networking, which will help Kenya manage and innovate these solutions internally over time, and the KDEAP (Kenya Digital Economy Acceleration Project) project expects to supplement investments from network operators by providing financial incentives to address the limited commercial viability of deploying fibre in remote areas.

Key findings

Kenya's experience demonstrates that effective policy coordination and public-private partnerships are essential for successful satellite deployment. The country shows how alignment

[84] Information shared by the Communications Authority in response to a questionnaire submitted by ITU.

between regulatory agencies (ICT Ministry, Communications Authority, Kenya Space Agency) ensures coherent policy implementation for satellite initiatives. When clear institutional roles are established, as seen in Kenya's framework, the impact of satellite technology can be significant and immediate.

Key factors driving Kenya's satellite connectivity progress include:

- **proactive regulatory reform**: Kenya's decision to permit 100 per cent foreign ownership for satellite companies reflects a strategic shift to attract global innovation and investment. This regulatory openness has enabled new entrants to rapidly expand services, increasing consumer options and affordability.
- **strong public-private collaboration models**: The partnership between KENET (Kenya Education Network) and satellite providers to connect remote university campuses shows how institutional users can effectively leverage satellite technology. These collaborations demonstrate that when public needs align with private capabilities, satellite adoption accelerates.
- **integration with broader connectivity strategies**: Kenya has incorporated satellite solutions within comprehensive initiatives such as the Digital Superhighway, recognizing complementary role of satellite alongside terrestrial options. This approach ensures satellite technology is deployed where it provides maximum benefit, particularly for remote schools and health facilities.
- **technology-neutral licensing frameworks**: Kenya's Unified Licensing Framework provides flexibility by focusing on service categories rather than specific technologies. This approach allows providers to choose the most appropriate technology solutions without unnecessary regulatory barriers.

Challenges

These are the key challenges affecting satellite connectivity expansion in Kenya:

- **affordability and pricing barriers**: Even with increased competition and price reductions, satellite services remain financially out of reach for many rural households and institutions. The high cost of terminal equipment and subscription fees represents a significant barrier to adoption, particularly in areas with lower income levels.
- **regulatory uncertainty**: The proposed increases in licensing fees for satellite ISPs could impact market development. Striking the right balance between generating revenue and encouraging market growth remains a challenge for regulators.
- **sustainable funding models**: Ensuring long-term sustainability for public satellite projects requires stable funding mechanisms. Many initiatives begin with donations or initial government funding that do not address ongoing operational costs.
- **technical expertise limitations**: There is insufficient local technical capacity to install, maintain, and troubleshoot satellite equipment, particularly in remote areas. This skills gap can lead to service interruptions and reduced effectiveness of connectivity solutions.
- **infrastructure gaps**: Limited reliable electricity access in rural areas poses a significant challenge for satellite deployment. Without consistent power for terminals, even well-designed satellite connectivity initiatives may falter.
- **device affordability**: Beyond connectivity costs, the limited availability and high cost of end-user devices (computers, tablets) constrains the practical benefits of satellite Internet access, particularly for educational institutions and healthcare facilities.

2.4. Nigeria

Market overview and development

Market structure

Nigeria's satellite communications market hosts a mix of domestic and international operators operating in both the geostationary-earth orbits (GSO) and non-geostationary-earth orbits (NGSO). Nigerian Communications Satellite Ltd (NIGCOMSAT) is Nigeria's indigenous satellite operator under the Federal Ministry of Communications, Innovation and Digital Economy (FMCI&DE) and owns and operates the **NigComSat-1R**–a quad-band (C, Ku, Ka, L-band) GSO satellite. It primarily serves public sector clients across communications, education, health, and security. NIGCOMSAT also leases capacity to private operators, supports rural broadband initiatives, and acts as an implementing partner for government connectivity programmes, with footprint extending across parts of Africa, Europe, and Asia.

Nigeria has also opened its market to many foreign satellite providers, resulting in a diverse array of GSO and NGSO systems serving the country, with the NGSO consisting of medium earth orbit (MEO) and low Earth orbit (LEO) systems. In general, the Nigerian Communications Commission (NCC) has issued over 90 Landing Permits to Space Segment Operators (who are mostly foreign companies) and has licensed over 25 indigenous operators to provide satellite services to last-mile customers[85].

These authorizations include major GSO operators such as Intelsat, Eutelsat, SES, Inmarsat, Yahsat, and Avanti, as well as emerging NGSO constellations operating in the LEO, such as OneWeb and SpaceX. In 2023, NCC granted landing rights to E-Space, a nascent LEO constellation focused on IoT connectivity, to serve "hardest-to-reach" areas with smart IoT solutions. Furthermore, numerous Nigerian companies operate as service providers using capacity leased from Space Segment satellite operators, all under licensing by NCC.

For example, from May 2022 till date, Starlink Internet Services Nigeria Limited (a local subsidiary of Space segment operator SpaceX received three operational licences from NCC (an International Gateway(for gateway services), an Internet Service Provider (for last-mile services) and a Sales & Installation-Major (for sale of terminals)) and 12 Frequency licences (for wireless services). These licences have enabled Starlink Internet Services Nigeria Limited (Starlink-NG) to offer high-speed, low-latency broadband to retail customers, and the licence duration is for an overall 10-year period.

OneWeb, who are also another emerging LEO provider, has taken on a slightly divergent approach to Starlink-NG and will not be providing services directly to end-users, but have forged distribution partnerships with local operators to deliver LEO connectivity in Nigeria. Additionally, Iridium (a LEO satellite phone/data network) obtained Nigerian Landing permits in 2020 for its LEO constellation to provide Mobile Satellite Service (MSS) capacity over Nigeria.

[85] Both the Space Segment and Ground Segment operators provide Fixed Satellite Services (FSS), Earth Station in Motion (ESIM), and Mobile Satellite Services (MSS).

Market share dynamics

Traditional GSO providers (Intelsat, SES, Eutelsat) historically dominated connectivity for banks, oil and gas companies and backhaul links. This is now shifting with new NGSO options. NIGCOMSAT, as a domestic operator, supports many government users and projects, but its exact market share is tied to public-sector demand and partnerships rather than retail subscriptions.

Comprehensive market share data for satellite broadband in Nigeria is still being collated and a database being developed by government authorities. The segment is nascent and NCC is still in the process of regularizing the services of providers operating without the required licences.

Despite this initial teething steps, the rapid uptake of NGSO operators have seen them take an early lead in the direct-to-consumer satellite Internet segment. Furthermore, these entries have expanded the market rather than displaced existing GSO services. GSO satellites still carry significant broadcast, backhaul, and corporate traffic, while LEO constellations are opening new markets in the broadband Internet segment. Mobile network operators (MNOs) are increasingly collaborating with satellite service providers to extend coverage (e.g., Airtel Nigeria's partnership with OneWeb - via OneWeb's deal with Airtel Africa). OneWeb also merged with one of Europe's biggest GSO operator, Eutelsat, leading to a multi-year agreement with NIGCOMSAT that aims to enhance connectivity for government, businesses and rural communities.

It is such strides that have led to increased affordability of satellite broadband as evidenced by the work done by the country's Broadband Implementation Steering Committee (BISC), who carried out an analysis in 2023 that found out that the average price for satellite broadband was estimated to be N434.83/1GB[2], exceeding the target price per GB of data of N390/GB set by the Nigeria's National Broadband Plan2020–2025 (NNBP) by about 10 per cent. However, it must be stated that this estimation of N390/1GB was made in 2020 and did not factor macroeconomic factors such as inflation, forex volatility, etc.

Table 5: Nigerian ISP subscriber counts by the end of 3Q 2024[86] (NCC)

ISP name	Subscribers
Spectranet Ltd.	105 441
Starlink Internet Service Nig. Ltd.	65 564
FiberOne Broadband Ltd.	33 010
Tizeti Network Ltd.	18 881
IpNX Nigeria Ltd.	16 166
Others	68 884

Nigeria has licensed 241 ISPs, of which only 124 had active users as of the third quarter of 2024, collectively serving more than 300 000 subscribers, according to NCC data[87].

[86] The NCC categorizes pure-play internet providers separately as ISPs and does not group them with traditional telecommunication companies, which also offer internet.

[87] The internet landscape is led by mobile network operators like MTN, Airtel, Globacom, and 9mobile, which collectively serve 132.4 million subscribers, providing both internet access as well as traditional phone services.

Recent developments

A notable trend in the past five years is the gradual transition from reliance on GSO Satellites to embracing NGSO constellations. Prior to 2019, virtually all satellite communications in Nigeria (apart from Iridium phones) used GSO spacecraft –for example, NigComSat-1R and foreign GSOs were used for VSAT Internet , DTH television, and trunking. Since then, LEO and MEO services have gained traction. The introduction of NGSO operators such as OneWeb and Starlink has demonstrated the performance advantages of NGSO. Starlink-NG service in Nigeria delivers speeds up to 150 Mbit/s with latency as low as 20 ms, a drastic improvement over the 600–800 ms latency of GSO links.

In practice, Nigeria is witnessing a complementary usage: GSO capacity is still used for broad coverage and less latency-sensitive needs, while NGSO (LEO/MEO) capacity is being utilized for broadband and MNOs are also leveraging the high throughput services from LEO operators to boost their coverage and access in underserved areas. This is expected to lead to increasing adoption of services such as E-banking, E-health, E- Education, E-Agriculture, etc.

Another example isa local satellite operator ViasatNigeria Limited(Viasat), which has recently obtained several licences (ISP licence, VSAT licence, and others) from NCC to introduce its broadband services in Nigeria. On a more recent note, Airtel Africa recently partnered with SpaceX to roll-out Starlink Internet access across nine countries in Africa, with Nigeria billed to be the first to receive such services[88].

In summary, the last five years have brought new global players and novel technologies (LEO broadband, satellite IoT) into the Nigeria market, intensifying competition and service options, including for underserved communities.

Regulatory framework and evolution

Institutional framework

Satellite communications in Nigeria are primarily regulated by the Nigerian Communications Commission (NCC), in line with the Nigerian Communications Act 2003. The NCC oversees licensing, spectrum management, and compliance for both space and ground segment operations. It issues landing permits to space segment operators and licences companies that provide satellite-based services in the ground segment, such as ISPs and VSAT operators. The NCC also ensures that satellite equipment is type-approved and meets technical standards.

In 2018, the NCC, pursuant to its powers under Section 2 and Section 70 (2) of the Nigerian Communications Act 2003 (NCA 2003), issued the Commercial Satellite Communications Guidelines, to regulate all Satellite Communications Services in all Orbits in Nigeria. Section 31 of the NCA 2003 strictly prohibits operations in the Communications Sector in Nigeria without an operating licence.

The National Space Research and Development Agency (NASRDA), on the other hand, is responsible for broader space science and technology development for the socio-economic benefit of Nigeria. In accordance with the NASRDA Act 2010, its statutory functions include the design, building, and launching of satellites; coordination of space-related research and

88 https://allafrica.com/stories/202505090364.html

development; formulation and implementation of the national space policy; supervision of relevant space science centres; serving as the repository of all satellite data over Nigeria's territory; and representing Nigeria in international space matters.

NIGCOMSAT Ltd is a government-owned company under the Federal Ministry of Communications, Innovation and Digital Economy (FMCI&DE). It is not a regulatory body but an operator and must itself obtain spectrum and orbital resources via the FMCI&DE and comply with NCC rules for services. It can advise the government on satellite initiatives and represent Nigeria in certain international fora. In the domestic market, NIGCOMSAT serves as the implementing arm for government satellite projects and a partner to private firms through public-private partnerships. By leveraging its communication satellite (NigComSat-1R) and expertise, NIGCOMSAT supports the NCC and the FMCI&DE in achieving universal access targets.

Legal and regulatory structure

The licence categories issued by NCC to companies seeking to provide communications services in Nigeria include: 1) Operational/Individual Licenses, which covers terms pertinent to the services being offered; 2) Spectrum Licenses, which covers Spectrum resource utilization and; 3) Class Licence which covers general authorizations.

Furthermore, NCC distinguishes between Space Segment Landing Permits[89] and Ground Segment licences[90] (which are all spectrum licences). The Space Segment Landing Permit is typically obtained by foreign satellite companies and does not allow direct provision of service to end-users. It however allows the Space Segment capacity to be sold to service providers licensed to operate in Nigeria. Ground Segment licences are required for operating earth stations, user terminals or providing communications services on the ground in Nigeria. These include licences such as VSAT Network Operator licences, Internet Service Provider (ISP) licences, Gateway Station licences, depending on the nature of the service.

Building on the 2018 Commercial Satellite Communications Guidelines, the NCC has, over the past five years, continued to refine and update its regulatory approach in response to technological evolution and market dynamics. In 2023, the NCC initiated a comprehensive review of the 2018 Guidelines, culminating in the presentation of a draft **Commercial Satellite Regulations** in 2023 for stakeholder consultation. The proposed updates include the incorporation of emerging services such as **Mobile Satellite Services (MSS)**, **High-Altitude Platform Stations (HAPS)**, and **Drone/UAV-based communications**, as well as revised licensing categories and fee structures to align with global industry best practices.

Public policy and universal access initiatives

According to NCC, about 27 million people in Nigeria (mostly in rural areas) lack access to telecommunication services, and as of September 2024, the country's broadband penetration

[89] Issued for free.
[90] The Commission issues spectrum licences to operators who have been licensed to provide services to the last mile. Each Spectrum License has an annual fee, and they are issued for a 10-year period. The Commission currently has six Network Frequency Licenses: 1) VSAT Earth Station Frequency Licence; 2) Earth Station Network Frequency Licence (ESIM); 3) Gateway Earth Station (GES) Frequency Licence; 4) UAV/Drone Network Frequency Licence; 5) High Altitude Platform Systems (HAPS) Network Frequency Licence; 6) Mobile Satellite Services (MSS) Network Frequency Licence.

stood at 41.56 per cent, while about 301 local government areas (LGAs), out of 774 total, have no Internet access. To address these gaps, the NNBP also incorporates the use of satellite services to complement terrestrial services. The plan sets extensive targets: broaden broadband penetration to 70 per cent by 2025 and ensure 90 per cent of the population has access to affordable, reliable broadband[91]. Furthermore, the Nigerian Government developed the National Digital Economy Policy and Strategy (NDEPS 2020-2030)[92], which is a comprehensive framework that is meant to guide the country's transition to a digital economy.

To support the targets set by the NNBP and NDEPS, the government (through the FMCI&DE and relevant agencies) has launched various programmes to provide reliable Internet access across the country. One flagship effort is "Project 774", which aims to enhance digital infrastructure[93], promote e-governance, and create employment opportunities to all 774 Local Government Area (LGA) secretariats across the country, thus bridging the digital divide and enhancing public service delivery. The Project 774 is coordinated by the FMCI&DE in collaboration with agencies such as Galaxy Backbone (a Federal Government owned nationwide IP-based network provider for connectivity and other infrastructure services), the Universal Service Provision Fund (USPF)[94], and NIGCOMSAT.

Galaxy Backbone Limited (GBB) has been mandated to be the main provider of broadband connectivity services to all government ministries, departments and agencies (MDAs).

Similarly, NIGCOMSAT has entered into partnerships with some operators (such as Hotspot Network Limited and Avanti) to deploy broadband services via the NigComSat-1R satellite platform to rural communities. These initiatives subsidize connectivity for community cyber centres, schools, and health centres in areas where no commercial operator provides service.

Other PPP examples include the NIGCOMSAT alliance with Inq. Nigeria, the partnership between NIGCOMSAT and OneWeb/Eutelsat[95] that brings together a State-owned Nigerian operator and a global satellite company to deliver LEO broadband for the public sector, businesses, and community use.

NIGCOMSAT has stated that such partnership is expected to reduce the portion of unconnected Nigerians in rural areas from 61 per cent to below 20 per cent by 2027.

Furthermore, **IHS Towers** (which operates 16,000+ towers in Nigeria) partnered with Avanti to equip **700 rural cell sites with satellite backhaul**, bringing 3G/4G coverage to areas that previously had none. This project, completed in2024, directly benefited anestimated3.5million people in Nigeria and won a "Universal Broadband Award" for its impact.

[91] Other goals of the plan are: 1) to deliver data download speed across Nigeria with a minimum of 25 Mbit/s in urban areas and 10 Mbit/s in rural areas; 2) price of not more than NGN 390/1GB of data (the average price for satellite broadband as of 2023 is NGN 434.83/1GB); 3) to utilize VSAT technology as an alternative to OFC or Microwave Technologies for network infrastructure.

[92] The policy launched in 2019 by the Ministry of Communications and Digital Economy aims to harness digital technologies to drive economic growth, create jobs, improve governance, and enhance national security.

[93] By leveraging existing infrastructures of the Nigerian Communications Satellite Limited (NIGCOMSAT) and Galaxy Backbone, the project seeks to establish robust internet connectivity in LGA (local government areas) secretariats.

[94] The USPF is a key initiative fund of NCC, established to bridge the digital divide in the country, promoting universal access to information and communication technology in underserved and unserved areas. It supports the partnerships established with the private sector.

[95] They merged in 2023 to form Eutelsat Group.

The combined effect of these initiatives is gradually improving rural connectivity metrics. As of late 2024, Nigeria's broadband coverage in rural areas reached approximately 40 per cent of the population.

The country recognizes that satellite technology bridges the gap of connectivity that cannot be provided by fibre and terrestrial services due to topology, inaccessibility of terrestrial signs, and fibre vandalization. It is a complimentary service to enhance universal access to data services to both rural and urban areas.

The quality of the data connectivity provided is being assessed based on the targets set in the Quality-of-Service Regulations, 2024. The NNBP 2020-2025 stipulates connectivity targets for schools in 100 per cent of Tertiary Institutions, 50 per cent Secondary Schools and 25 per cent Primary Schools connected in 2025. For health clinics, 80 per cent of primary health centres in each LGA and 100 per cent of general major hospitals per LGA are connected.

The NNBP estimated that 90 per cent of local governments can be connected with fibre, and the remaining 10 per cent through satellite and other technologies.

Table 6: 2020-2025 Nigerian National Broadband Target

No.	Key Area	Details	Indices	Targets (2025)
1	**Coverage of Population**	Individuals	4G[1]	4G/5G mobile at 90% population coverage
2	**Speed**	Urban	Minimum Download speed[2,3]	10Mbps by 2023 25 Mbps by 2025
		Rural	Minimum Download speed	5Mbps by 2023 10 Mbps by 2025
3	**Penetration**	Number of connected individuals	Youth > 15yrs and Adults	70% of eligible individuals
4	**Fibre Reach**	Schools	Ensure Fibre build such that institutions are within 5km of fibre manhole or with a fixed connection	100% Tertiary Institutions[4] 50% Secondary Schools 25% Primary Schools
		Health Facilities		Connecting 1 General or Major Hospital per LGA and Federal Medical centres
		Local Govts.	Build in state capitals and major cities	90% of (774) Local Govts. HQ (secretariat) connected by Fibre. 10% by Satellite / Fixed /Other in hard to reach areas.
		Fibre to Towers	% Towers Connected	60% of Towers Connected
		Fibre Infrastructure	Open access shared Fibre	Minimum 120,000km needed. Non overlapping routes. All major roads, Federal + State. Minimum: 90% of LGAs
5	**Affordability:** **Data**	1GB for Data over 1 Month "1 for 2"	2% of median income/Capita i.e. 2% of (N19,460/month) @ N360/$1	N390 / 1GB

Regarding community-led networks and initiatives, some, such as the Centre for Information Technology and Development (CITAD), are supported by international partners, including the United Kingdom Digital Access Programme and the Association for Progressive Communications (APC). CITAD has pioneered community network projects in northern Nigeria, particularly in remote areas of Bauchi State and rural communities around Abuja.

CITAD networks focus on local empowerment, providing training for community members to manage these networks and engaging local governments to support digital inclusion efforts. These networks are characterized by their localized infrastructure and management, often powered by renewable energy sources, such as solar. They serve as a key model for last-mile connectivity, aiming to provide affordable Internet access in areas where traditional telecommunication infrastructure is unfeasible.

Key findings

Based on Nigeria's experience with satellite connectivity and its regulatory framework, several key findings emerge:

- **Proactive regulatory framework development**: Nigeria has developed a clear regulatory structure with NCC as the regulator for satellite communications and NASRDA as the lead Space research Agency for the country. NCC has issued specific guidelines for both space segment permits and ground segment licences and established detailed Commercial Satellites Communications Guidelines in 2018, which has created a stable environment for satellite operators.
- **Balanced approach to market openness**: Nigeria has successfully balanced opening its market to international operators (with over 90 landing permits issued) while maintaining strategic national assets through NIGCOMSAT. This dual approach ensures both innovation from global players and preservation of national interests.
- **Strategic public-private partnerships**: Following Brazil's example, Nigeria has effectively leveraged public-private partnerships to extend connectivity. Projects such as the NIGCOMSAT collaboration with Hotspot Network Limited and Avanti demonstrate how these partnerships can accelerate rural connectivity goals, potentially reducing unconnected rural populations from 61 per cent to below 20 per cent by 2027.
- **Complementary technology approach**: Nigeria has recognized that satellite technology should complement terrestrial technologies rather than compete with them. This is evident in the National Broadband Plan stipulating that 10 per cent of all connectivity can be done via satellite, acknowledging its specific value in areas where fibre and terrestrial services face challenges.
- **Community-led networks**: The development of community-led initiatives such as those supported by the Centre for Information Technology and Development (CITAD) shows promising results in empowering local communities to manage their own connectivity solutions, creating sustainable models for last-mile access.

Challenges

Despite significant progress, Nigeria faces several challenges in fully leveraging satellite technologies for connectivity:

- **Affordability and quality of services**: Economic pressures make it difficult to maintain affordability while ensuring service quality, particularly with the target of NGN 390/1GB as stipulated in the NNBP 2020-2025. This target though is now in need of review to reflect current economic realities.
- **Infrastructure security and power**: Ground equipment in rural and high-risk areas remains vulnerable to vandalism, theft, and power instability. The lack of consistent electricity supply necessitates investment in solar or hybrid power solutions, which adds to project costs.
- **Digital sovereignty considerations**: The increasing demand of global players raises concerns about market concentration, digital sovereignty, and data governance. There

is a need for striking a delicate balance between openness to foreign investment with safeguards for national interests and local capacity development.

- **Device affordability for end-users**: The high costs of terminal devices for rural dwellers and low-income earners present a significant barrier to adoption, even when satellite coverage exists.
- **Domestic capacity building and technical expertise**: With NIGCOMSAT-1R approaching the end of its 15-year lifespan by 2026, Nigeria faces challenges in developing the technical expertise needed for satellite operations and maintenance, as well as funding for replacement satellites
- **Sustainable funding mechanisms**: Satellite deployment, especially in remote areas, involves high upfront and recurring costs. Although programmes such as Project 774 and public-private partnerships are helping, long-term funding mechanisms for both deployment and operational sustainability remain uncertain.
- **Inadequate local manufacturing ecosystem:** The absence of a domestic ecosystem for satellite components or terminal device manufacturing results in heavy import dependency. This makes Nigeria vulnerable to foreign exchange shocks and limits local value capture from satellite projects.

2.5. South Africa

Market overview and development

Market structure

South Africa's satellite Internet market comprises of a mix of domestic service providers partnering with international satellite operators. YahClick (operated via UAE's Yahsat and Hughes) is a leading service, delivered locally through Vox Telecom and a recent partnership with Telkom, aimed at reaching customers beyond the fibre footprint. Other players include Eutelsat's Konnect service, Viasat/Inmarsat, and regional providers such as Paratus and MorClick, which resell capacity to remote farms and businesses. Traditional telecommunication operators have also utilized satellite for niche needs – for instance, Vodacom and MTN use geostationary links to backhaul cellular sites in hard-to-reach areas.

Mobile Network Operators (MNOs) are focused on providing Internet connectivity, covering around 90 per cent of the population, which makes them the default Internet option, even in many rural areas.

Recently, there has been a technological shift taking place in the country, from one-way GEO links (e.g. satellite television-style connectivity to schools) to two-way high-throughput satellites (HTS) in Ka-band and LEO systems. For instance, NEC XON, in partnership with Skywire, has successfully deployed an innovative OneWeb satellite solution tailored to meet the connectivity challenges faced by rural communities and remote enterprises across South Africa. These NGSO services promise to improve performance and broaden the appeal of satellite. Telecommunication operators in South Africa have responded to these trends by exploring collaborations. Cell C (the country's fourth-largest mobile operator) is in talks with LEO providers to deliver affordable broadband to rural regions.

Market dynamics and recent developments

SpaceX Starlink has shown an interest in entering South Africa's market, although its plans are being delayed due to internal reasons with the country's regulations. Investors in South Africa, across all sectors including the telecommunication sector are required to provide 30 per cent of the equity to Historically Disadvantaged Individuals (HDIs) to conduct business in the country and to qualify for a licence.

The arrival of high-throughput satellite options has intensified competition in previously underserved broadband segments. Historically, satellite Internet was seen as a complement for off-grid areas, not a direct competitor to mainstream broadband. This is changing as NGSO constellations target regular consumers. The consensus is that satellite services will complement national connectivity goals – filling coverage gaps in remote areas – rather than capturing a large share of urban markets.

Regulatory framework and evolution

Institutional framework

The Independent Communications Authority of South Africa (ICASA) is the chief regulator overseeing telecommunications (including satellite communications), broadcasting, and postal services. ICASA is responsible for licensing satellite services, licensing and managing spectrum, and ensuring compliance with telecommunications laws. The Minister of Communications and Digital Technologies, sets national policy and issue policy directives that can influence regulation.

Legal and regulatory structure

South Africa's regulatory regime is grounded in the Electronic Communications Act (ECA), which established a technology-neutral licensing framework. Under this regime, satellite operators generally require an Individual Electronic Communications Network Service (IECNS) licence (to operate infrastructure) and an Electronic Communications Service (ECS) licence (to provide services to end users nationally) – the same categories are used for telecommunication operators. Also mandatory is the Radio Frequency Spectrum License (RFS Licence) required for any entity transmitting signals via radio frequencies. Licensing/authorization of the radio frequency spectrum required by satellite services is regulated by the Radio Frequency Spectrum Regulations (2015), while the applicable licensing fees for satellite services are regulated by Radio Frequency Spectrum Licence Fee Regulation (2010).

The current regime requires telecommunication licensees to be a South African entity with at least 30 per cent of its equity ownership to be held by historically disadvantaged individuals (HDIs), in line with the country's Broad-Based Black Economic Empowerment (BBBEE) policies. Non-compliance with this policy can result in penalties, including fines of up to R5 million or 10 per cent of annual turnover. This requirement, updated in 2021[96], has had direct implications for foreign satellite ventures seeking to operate independently in the country. For instance,

[96] In April 2021, the Independent Communications Authority of South Africa (ICASA) introduced regulations requiring both applicants, for new licences and existing licensees seeking licence renewals or amendments, to comply with this 30 per cent HDP ownership criteria.

Starlink claimed claims to "not be allowed to operate in the country", although ICASA has confirmed that the company has never submitted an application for a licence.

ICASA is revisiting the licensing framework for satellite services and was expected to announce a new licence framework for satellite-based Internet services by April 2025. In August 2024, the regulator published a call for public comments on the proposed new Licensing Framework for Satellite Services and received 47 written submissions. This was followed by a public hearing from 5-7 February 2025, to discuss the submission and for entities to further elaborate on their respective submissions. The debates centred around balancing the need to attract foreign investment and advanced technologies with the imperative of upholding South Africa's transformation and empowerment objectives. Regulatory clarity, technological innovation, fair competition, and the expansion of services to underserved areas were also discussed.

The ICASA chairperson, Mothibi Ramusi, recognized that, while the regulator has always embraced satellite communications, "new emerging technologies may require a totally different licensing framework"[97]. The focus is on accommodating NGSO networks within the existing legal structure. ICASA has proposed introducing three types of licences in the new framework (satellite gateway at station, user terminal network, and registration of "space segment" for satellite operators).

South Africa's regulatory environment for satellites is in flux, evolving to accommodate new technologies and players. The country tries to ensure that the regulatory regime remains fair, transparent, and aligned with national interests (both in terms of investment and social obligations).

Public policy and universal access initiatives

A flagship programme is South Africa Connect (SA Connect), the country's broadband policy launched in 2013 and in 2022, Cabinet approved the revised SA Connect Phase 2. Phase 2 Implementation began in late 2023.

In May 2024, the government announced plans to connect 5.5 million households in rural areas and townships via Wi-Fi hotspots over the next 3–4 years.[98] These community Wi-Fi hotspots provide affordable Internet access (as low as 5 rand per day for 1 GB of data, or 250 rand per month for unlimited use). The initiative is part of SA Connect Phase 2, aiming to reach 80 per cent of public institutions, communities, and homes with broadband within three years. Phase 1 of the project focused on providing 10 Mbit/s of Internet connectivity to nearly 970 essential public administrations, prioritizing public schools and public health centres.

Satellite technology is used for challenging geographical locations that do not have a line of sight, i.e. O.R Tambo (Tambo District Municipality) in the Eastern Cape province. According to the USAASA, satellite technology has been used to connect 61 public schools and health centres.

97 See: https://www.itweb.co.za/article/icasa-readies-new-satellite-framework-amid-starlink-hold-up/LPp6V7rBGwR7DKQz. In June 2025, the regulator started seizing Starlink kits from local resellers, arguing that the satellite provider does not have a licence to operate in South Africa. Source: https://techpoint.africa/news/south-africa-seizes-starlink/

98 https://www.africanwirelesscomms.com/news-details?itemid=7630

South Africa is also pursuing a longer-term strategy of developing sovereign satellite infrastructure. In November 2024, the Departments of Communications and Digital Technologies (DCDT) and Department of Science and Innovation (DSTI), along with the South African National Space Agency (SANSA) and Sentech, unveiled progress on a National Communication Satellite Strategy (SatCom). This ambitious project (announced in 2021) calls for investing roughly ZAR 5.2 billion (≈ USD 288 million) to build and launch South Africa's own communications satellite. The goal is to narrow the country's digital divide, enhance connectivity in underserved areas, and establish South Africa as a leader in satellite technology. The SatCom project still faces hurdles – securing an orbital slot, funding, and building local skills are key challenges.

Cross-sector collaboration between government, NGOs, and private satellite providers has been crucial in improving connectivity for public services. For instance, MorClick (a local satellite ISP) and YahClick partnered to support the NGO KHULA Education by providing three months of free uncapped satellite Internet to 15 rural schools in Zululand during the COVID-19 pandemics.

Satellite links are also being considered to connect clinics in areas where terrestrial networks are absent, ensuring telemedicine and health information systems can function consistently, and for disaster recovery and resilience – the ICASA proposed framework cites the importance of satellite in maintaining communications during natural disasters or extreme weather events when terrestrial networks might be down.

In addition, telecommunication operators are increasingly involving satellite in their rural expansion plans. Cell C and MTN have indicated interest in using LEO satellite connectivity to extend coverage to rural populations at lower cost than building towers in every village.

The government's inclusive approach – utilizing a mix of fibre, mobile, Wi-Fi and satellite – means that satellite technology is firmly recognized as an integral tool for achieving universal service.

Financial support structure

The finance structure to support these policies includes the Universal Service Access Fund (USAF), which telecommunication licensees are legally obligated to make annual contributions. The fund aims to ensure that telecommunication services are accessible to all citizens of South Africa, regardless of their location or socio-economic status. This often involves subsidizing infrastructure development in underserved areas and promoting affordability.

The Broadband Access Fund is implemented by Broadband Infraco, a state-owned entity established to expand broadband infrastructure, and focus on broadband access. The Presidency provides the funding through direct allocations from the government budget, in line with the National Development Plan 2030 (NDP 2030), a long-term strategic plan that outlines the country's development goals. The fund is provided through the Department of Communications and Digital Technologies (DCDT). The fund provides partial subsidies to Internet Service Providers (ISPs), particularly Small, Medium and Micro Enterprises (SMMEs), to expand broadband in underserved, low-income areas. The fund's operational framework includes rigorously determined subsidy values, eligibility criteria[99], and location specifications to ensure effective targeting of underserved communities.

[99] One of the eligibility criteria for ISPs include being SMMEs (Small, Medium, and Micro Enterprises) with a focus on empowering youth, women, and people with disabilities.

Key findings

In summary, South Africa's experience demonstrates several important lessons for effective satellite policy implementation:

- **Regulatory adaptation to technological change**: South Africa's proactive approach to updating its satellite licensing framework shows how regulators can effectively respond to rapid technological evolution while balancing multiple policy objectives. The ICASA ongoing public consultation process for a new satellite licensing framework demonstrates commitment to inclusive, evidence-based policymaking that considers diverse stakeholder perspectives.
- **Balancing transformation goals with investment attraction**: South Africa's approach highlights the importance of aligning economic transformation objectives with the need to attract foreign investment and cutting-edge technologies. This delicate balance requires innovative regulatory solutions that fulfil socioeconomic development goals while creating an enabling environment for technological advancement.
- **Integration of satellite into national broadband strategy**: The SA Connect programme exemplifies how satellite technology can be effectively integrated into a broader connectivity strategy alongside fibre, mobile, and community Wi-Fi solutions. South Africa's technology-neutral approach ensures that satellite is recognized as an important tool for reaching underserved populations rather than being treated as a separate, parallel initiative.
- **Long-term vision for sovereign satellite infrastructure**: The National Communication Satellite Strategy demonstrates how developing countries can pursue technological sovereignty while maximizing immediate benefits from existing commercial satellite solutions. The multi-stage approach allows South Africa to build capacity and experience while working toward more ambitious, nationally-owned infrastructure.

Challenges

South Africa continues facing several challenges in expanding satellite-based connectivity:

- **Affordability barriers**: With 1GB of mobile data costing approximately 5.7 per cent of monthly income in South Africa, cost remains a significant obstacle to widespread Internet adoption. This economic reality creates challenges for satellite service providers who must balance commercial viability with accessibility for lower-income users, particularly in rural areas where satellite may be the only connectivity option.
- **Regulatory reform implementation**: While ICASA has initiated the process to update satellite licensing frameworks, the completion and effective implementation of these reforms remains challenging. Balancing the need for local ownership and empowerment with creating an attractive environment for global satellite operators requires careful policy calibration and clear transition pathways.
- **Institutional capacity and technical expertise**: Building sufficient regulatory capacity to effectively oversee increasingly complex satellite technologies requires continuous investment in skills development and knowledge transfer. South Africa, as with many developing countries, faces challenges in recruiting and retaining specialized satellite regulatory expertise within government institutions.
- **Infrastructure gaps beyond connectivity**: The effectiveness of satellite connectivity is constrained by related infrastructure challenges, particularly unreliable electricity supply in rural areas. These complementary infrastructure gaps require coordinated policy approaches across multiple government departments and investment programmes.

- **Sustainable funding mechanisms for public access**: Developing sustainable funding models for satellite-based public service connectivity remains challenging. The Universal Service Access Fund and other financing mechanisms need continuous refinement to ensure long-term sustainability of remote connectivity initiatives beyond initial deployment phases.

3. Cross-country comparisons

There are diverse approaches to satellite connectivity implementation across regions. By examining multiple dimensions (regulatory frameworks, market dynamics, policy debates, and implementation challenges) of the five key countries analysed (Brazil, Indonesia, Kenya, Nigeria, and South Africa), both successful strategies and common barriers can be identified. The patterns that emerge from this analysis reveal how different policy environments shape satellite technology adoption. In this sense, it is possible to understand how satellite technology can be effectively leveraged as part of a comprehensive digital inclusion strategy in diverse developmental contexts.

3.1. Regulatory framework

Regulatory frameworks play an essential role in either accelerating or hindering the expansion of satellite technology in developing countries. The frameworks are the foundation upon which satellite technology can meaningfully contribute to digital inclusion and development. In countries such as Indonesia, with its unique geographical challenges spanning thousands of islands, well-designed regulatory policies become the invisible infrastructure enabling visible progress.

The difference between an enabling regulatory environment and a restrictive one can determine whether satellite technology remains an underutilized resource or becomes a transformative force for connecting the unconnected in remote communities.

Effective frameworks address multiple dimensions:

- They allocate spectrum efficiently, ensuring satellite operators have access to necessary frequency bands while preventing harmful interference; they establish reasonable licensing requirements that balance oversight with accessibility for new market entrants.
- They promote healthy competition that drives down costs while maintaining service quality.
- They harmonize domestic policies with international standards, facilitating cross-border operations essential for satellite services.
- They create pathways for knowledge transfer and local capacity building, transforming satellite technology from an imported solution to a catalyst for domestic innovation.
- They incorporate universal service principles that extend connectivity to those most in need.
- They address evolving security and privacy concerns that build trust in satellite-based services.

Regarding regulatory frameworks, it is important to assess some main topics that shape how satellite technologies are governed, deployed, and utilized across countries, such as:

1) **Key regulatory bodies**: the government institutions and agencies responsible for satellite telecommunications oversight in each country.
2) **Licensing approach**: the processes, requirements, and frameworks countries use to authorize satellite operators.
3) **Foreign ownership**: this criterion assesses restrictions or allowances regarding foreign investment and ownership in satellite telecommunication sectors. Policies range from fully open markets that permit 100 per cent foreign ownership (as seen in Indonesia's

2021 regulatory change) to more restrictive environments requiring local partnerships or imposing ownership caps.

4) **Recent updates**: significant regulatory changes, amendments, or new legislation enacted within approximately the last 24-36 months. Recent updates demonstrate how countries are adapting their frameworks to accommodate technological innovations, particularly NGSO constellations.

Highlights

- Different countries operate with different frameworks, although some similarities are observed.
- All countries operate a "landing rights" approach for foreign satellites operators, despite their framework being unified or separated.
- All of the countries are also updating and working on their legislation to accommodate NGSO constellations.

Below is a comparative overview of satellite communications regulations across the five key countries of the study. The "key regulatory bodies" column identifies the primary government agencies and ministries responsible for overseeing satellite communications within each country. Understanding these entities is crucial for operators seeking to navigate the regulatory landscape, as they are the gatekeepers for licensing and compliance requirements.

The "licensing approach" column outlines the specific authorization frameworks and permits required to operate satellite services in each jurisdiction. Meanwhile, "foreign ownership" examines the restrictions or allowances regarding international investment in satellite communications ventures. This column reveals whether countries permit 100 per cent foreign ownership, impose ownership caps, or require local participation.

Table 7: Satellite regulatory framework by country

Country	Key regulatory bodies	Licensing approach	Foreign ownership
Brazil	ANATEL, Ministry of Communications	Satellite Landing Rights Authorization (15-years + 15-years renewal)	100 per cent allowed Allows satellite operators to provide services through locally incorporated legal representatives
Indonesia	Komdigi, BAKTI	Satellite Landing Rights; Internet Service Provider permits	100 per cent allowed since 2021 reforms
Kenya	Communications Authority (CA), Kenya Space Agency	Unified Licensing Framework; Satellite Landing Rights	100 per cent allowed

Table 7: Satellite regulatory framework by country (continued)

Country	Key regulatory bodies	Licensing approach	Foreign ownership
Nigeria	NCC, NASRDA	Landing permits for space segment; separate ground segment licences	100 per cent allowed
South Africa	ICASA, Ministry of Communications	IECNS and ECS licences; spectrum authorization (RFS License)	30 per cent ownership requirement[100]

Table 8: Main recent regulatory updates

Country	Regulatory approach
Brazil	Expansion of its regulatory framework (2023-2024). Resolution 748/2021 updated satellite licensing framework and regulatory sandbox introduced in 2024
Indonesia	Allowed 100 per cent foreign investment in satellite telecommunications activities (2021) - Presidential Regulation No. 10 of 2021 (PR 10/2021)
Kenya	Kenya Space Bill 2024
Nigeria	Draft "Commercial Satellite Regulations" under development (2023-2025)
South Africa	ICASA is revisiting the country's licensing framework (expected for announcement in 2025)

Similarities

- All countries operate a "landing rights" approach for foreign satellite operators.
- Most have separated space segment and ground segment licensing.
- Recent regulatory reforms to accommodate LEO constellations in all countries.
- Movement toward longer licence periods (10-15 years) for regulatory certainty.

Differences

- South Africa's 30 per cent ownership requirement is unique among the surveyed countries, illustrating the need to consider local contexts.
- Fee structures vary significantly
- Brazil implemented a regulatory sandbox for emerging technologies, including amongst others direct-to-device (D2D) connectivity. Kenya is developing a new Framework for

[100] Foreign companies must be registered with its principal place of business located within South Africa and 30 per cent of the ownership in telecommunication services in South Africa must be held by historically disadvantaged groups.

Emerging Technologies and has established a Global Innovation and Entrepreneurship Centre (GIEC), although not specifically addressing satellite connectivity for now.

3.2. Market dynamics

Market dynamics refer to the forces, patterns, and competitive relationships that shape how a market operates and evolves. In the context of satellite telecommunications, market dynamics encompass for example the leading operators, market entrants, subscriber numbers, government satellite assets, and the competitive landscape that influences market development.

The comparative analysis reveals that satellite telecommunication markets in Brazil, Nigeria, Kenya, Indonesia, and South Africa are all experiencing significant transformation with the entry of low Earth orbit (LEO) constellation services. While traditional geostationary (GEO) satellite providers still maintain presence in these markets, they face increasing competitive pressure from new global entrants, which have rapidly gained substantial market share in multiple countries.

Highlights

- Brazil has emerged with the largest satellite subscriber base among the analysed countries, with over 562 000 satellite subscribers. This rapid dominance has prompted regulatory concerns about digital sovereignty and market concentration;
- In Kenya, Starlink has achieved significant market dominance, capturing 98 per cent of the satellite market despite representing only 1.1 per cent of the country's fixed broadband connections;
- Nigeria's market is characterized by its strategic approach to domestic satellite capability. The country operates its own satellite (NigComSat-1R).

The following table provides a comprehensive overview of the satellite Internet landscape across the five key countries. The data illustrates the current competitive dynamics and infrastructure development in these rapidly evolving telecommunications markets.

- Leading operators: identifies the dominant satellite Internet service providers in each market.
- Significant new entrants: highlights major companies that are either newly entering these markets or planning to launch services.
- Subscriber numbers: provides publicly available data on the number of satellite Internet subscribers in each country.
- Government satellite assets: documents each country's sovereign satellite infrastructure, including both operational government-owned satellites and planned developments.

Table 9: Satellite Internet market overview by country

Country	Leading operators	Significant new entrants	Subscriber numbers	Government satellite assets
Brazil	Starlink (58.0%), Hughes (30.4%), Viasat (3.6%)	OneWeb, E-Space, Project Kuiper (pending)	Over 562 000 satellite subscribers	SGDC-1 (Telebras)
Indonesia	Telkomsat, PSN, Indosat	Starlink (2024 entry)	Not specified; demand estimated at 1TBPS by 2030	Multiple (Telkom, Nusantara series, SATRIA-1)
Kenya	Starlink (98% of satellite market, 1.1% of fixed broadband)	OneWeb, potential additional LEO entrants	17 042 satellite subscribers	None (considering development)
Nigeria	NIGCOMSAT, various VSAT providers	Starlink, OneWeb/Eutelsat, E-Space	Data not available	NigComSat-1R (expiring 2026)
South Africa	YahClick/Vox, Eutelsat Konnect, Paratus	OneWeb (operational), Starlink (pending)	Limited market share (exact numbers not provided)	None (considering national satellite)

Similarities

- All markets show rapid growth of LEO constellations.
- Traditional VSAT/GEO providers facing competitive pressure.
- Satellite remains a niche segment compared to terrestrial broadband.
- All are seeing increased competition with new global entrants.

Differences

- Brazil currently has the largest satellite subscriber base (over 560 000),
- Kenya currently has highest domination by a single satellite operator (98 per cent of satellite market).
- Indonesia and Nigeria currently maintain stronger domestic satellite operators.
- South Africa's market access is currently constrained by ownership requirements.

3.3. Key policy debates

Governments, regulators, and industry stakeholders navigate policy debates in satellite telecommunications with central discussions and contentious issues for developing effective frameworks for satellite services. These debates revolve around balancing national interests with technological advancement, addressing competitive concerns, determining infrastructure investment strategies, and ensuring affordable access for citizens.

The analysis reveals that all five countries are grappling with similar fundamental questions about how to regulate and integrate satellite services, though each approach these debates through their unique socioeconomic and political contexts. The debates reflect the tension between embracing innovation and protecting national interests, with policy positions evolving as market realities and technologies change. Among the topics discussed by all of the countries are how to create level playing fields between incumbents and new entrants and how to make satellite services financially accessible.

Highlights

- South Africa's policy debate has a remarkable topic that considers the intersection of telecommunication policy with broader socioeconomic transformation goals.
- Indonesia has implemented strong digital sovereignty measures by requiring local network operation centres within its borders for satellite operators.

The table below presents an overview of the key policy debates surrounding satellite Internet services in five emerging economies. Each column represents a critical dimension of the policy landscape.

- Digital sovereignty: refers to how countries are asserting control over their national digital infrastructure and telecommunications services. This includes concerns about foreign ownership and control of critical Internet infrastructure, requirements for local partnerships or facilities, and efforts to develop domestic satellite capabilities to reduce dependence on international providers.
- Competition concerns: addresses regulatory debates about market fairness and competitive dynamics. This encompasses issues such as licensing frameworks, market entry conditions for new satellite operators, protests from incumbent telecommunications providers, and efforts to ensure equitable treatment of all service providers under national regulatory frameworks.
- Infrastructure investments: outlines each country's strategic investments in national satellite infrastructure and connectivity. This includes government-funded satellite programmes, plans for additional national satellites, partnerships with private operators, and subsidies for public facilities or underserved areas.
- Service affordability: examines pricing structures and accessibility of satellite Internet services. This column highlights the cost of services relative to local economic conditions (such as minimum wages), government efforts to reduce barriers to access through subsidies, hardware cost reductions promoted through competition, and specific pricing for data services.

Table 10: Key satellite Internet policy debates in emerging markets

Country	Digital sovereignty	Competition concerns	Infrastructure investment	Service affordability
Brazil	Assessing impact of Starlink's dominance on digital sovereignty	In April 2025, ANATEL announced[101] it would further study how to address competition concerns and potentially review licensing framework. There is no specific deadline to complete this study.	Discussions about SGDC-2 (undecided)	Satellite Internet monthly cost: ZAR 179 to 399 (minimum wage per month ZAR 1 518)
Indonesia	Requiring local network operation Centres within borders	Traditional vs. new technology competition	SATRIA-1 (150 Gbit/s) operational in 2024, SATRIA-2 planned	Government subsidizes connectivity for public facilities
Kenya	Debates about requiring LEO providers to partner with local operators	Incumbents filed protests about Starlink entry conditions	Exploring community network models	Starlink reduced hardware costs from KEN 89 000 to KEN 45 000 (minimum wage per month: KEN 15 201.65[102])
Nigeria	Building domestic satellite capability (replacing NigComSat-1R)	Debates over tariff regulations for satellite services and equitable access (level playing field) for mobile operators (equal adherence to regulatory rules and compliance without exceptions)	Plans for additional national satellites	Not specified, but affordability for rural areas is a key concern
South Africa	National Communication Satellite Strategy (SatCom) development	Mobile operators seeking satellite partnership requirements	ZAR 5.2 billion USD 288M) investment planned for national satellite	1 GB of data via Wi-Fi hotspots price at ZAR 5 per day (minimum wage per month: ZAR 4 989.88[103])

Similarities

- Digital sovereignty concerns about foreign satellite dominance.

101 https://www.gov.br/anatel/pt-br/assuntos/noticias/anatel-aprova-alteracao-do-direito-de-exploracao-do-sistema-starlink-e-emite-alerta-regulatorio
102 https://tradingeconomics.com/kenya/minimum-wages
103 https://www.labour.gov.za/DocumentCenter/Publications/Basic%20Conditions%20of%20Employment/National%20Minimum%20Wage%20flyer%202025.pdf

- Debates about "levelling the playing field" between incumbents and new entrants.
- All considering some form of domestic satellite capability.
- Affordability remains a challenge in all markets.

Differences

- Indonesia has imposed requirements to ensure that critical data, systems and network equipment (e.g. network operation centres) remain within its territory, under domestic jurisdiction
- The debates are on the need for regulatory clarity, technological innovation, fair competition, and balancing the need to attract foreign investment and adoption of advanced technologies with the imperative of upholding South Africa's transformation and empowerment objectives
- Debates over retail tariff regulation in Nigeria

3.4. Implementation challenges

The countries can face some practical obstacles and difficulties to deploy, maintain, and expand satellite telecommunication infrastructure and services. These challenges encompass technical barriers, financial constraints, infrastructure gaps, and regulatory issues that can impede the effective implementation of satellite communications systems and services. These challenges are often interconnected, technical issues compound financial constraints, infrastructure gaps limit service delivery, and regulatory frameworks sometimes struggle to keep pace with technological advancement.

Common implementation challenges from the five countries analysed are:

- **Funding constraints**: financial limitations that restrict the development, deployment, maintenance, and expansion of satellite telecommunication infrastructure. This includes capital expenditure for satellite procurement or capacity leasing, ground infrastructure investment, operational costs, and lifecycle management expenses. Satellite systems require substantial upfront investment and ongoing funding commitments. All of the analysed countries face challenges securing sustainable funding for long-term satellite programmes.
- **Technical expertise gaps**: shortage of specialized knowledge, skills, and human resources needed to effectively design, implement, operate, and maintain satellite communications systems. This encompasses expertise in satellite engineering, spectrum management, network operations, ground infrastructure maintenance, and related specialized technical domains. Satellite telecommunications represent one of the most technically complex forms of communications infrastructure, requiring multidisciplinary expertise across aerospace engineering, radio frequency management, networking protocols, and specialized regulatory knowledge. All of the countries analysed face challenges with technical capacity constraints, even the ones with significant telecommunication development.
- **Regulatory balance**: the challenge of creating satellite telecommunication frameworks that simultaneously encourages innovation and market development while protecting national interests; adequate oversight without creating bureaucratic barriers; and promotes competition, while preventing market concentration or predatory practices. Satellite telecommunications exist at the intersection of rapidly evolving technology, complex international coordination requirements, and significant national interests in connectivity, sovereignty, and economic development. In this sense, finding the appropriate regulatory balance is essential. All of the five key countries are constantly working on updating their legislations to address new technologies and scenarios of satellite telecommunication.

- **Electricity access limitations**: insufficient or unreliable electrical power infrastructure in remote and rural areas where satellite services are often most needed. This includes areas completely off the electrical grid, regions with intermittent power supply, or locations with inadequate power quality (voltage fluctuations, frequent outages). Satellite telecommunications equipment requires consistent electrical power to function properly. These kinds of limitations are particularly evident in Kenya, Indonesia, and South Africa.

The following table presents a comprehensive analysis of the challenges faced by the five key countries in implementing satellite technology and telecommunications infrastructure. The challenges are organized into four distinct categories.

- Technical barriers: refers to the engineering and technological challenges that countries encounter when deploying satellite systems. These include issues such as spectrum management complexities, satellite lifecycle concerns, geographical obstacles, and the technical difficulties of maintaining reliable services across diverse terrains. Technical barriers often stem from the sophisticated nature of satellite technology and the specialized expertise required for implementation and maintenance.
- Financial constraints: encompasses the economic challenges and funding limitations that impede satellite technology deployment. This category covers issues such as the high capital costs of satellite systems, difficulties in securing sustainable financing models, limitations in public funding availability, and the financial viability of maintaining and replacing aging satellite infrastructure. These constraints often represent the most significant hurdle for many developing nations seeking to expand their telecommunication capabilities.
- Infrastructure gaps: describes the missing or inadequate physical infrastructure necessary to support satellite technology implementation. This includes deficiencies in ground-based gateway infrastructure, insufficient electricity supply in remote areas, limited manufacturing capabilities, and gaps in the supporting infrastructure needed for satellite operations.

Table 11: Satellite technology implementation challenges

Country	Technical barriers	Financial constraints	Infrastructure gaps
Brazil	Spectrum management for growing constel-lations	Financial sustainability of Telebras	Gateway infrastructure for new constellations
Indonesia	Geographical challenges across 17,000+ islands	Transitioning from free to sustainable models in rural and remote areas	Electricity availability in remote areas
Kenya	Electricity access in remote areas	High equipment costs despite reductions	Limited gov. funding and private investment, and manufacturing capabilities
Nigeria	Satellite lifecycle management (NigComSat-1R expiring)	Funding for satellite replacement	Funding constraints in general

Table 11: Satellite technology implementation challenges (continued)

Country	Technical barriers	Financial constraints	Infrastructure gaps
South Africa	Securing orbital slots for national satellite (SatCom project)	Public funding limitations	Rural electric supply needs, and technical skill gaps

These implementation challenges underscore the fact that satellite telecommunications success depends not just on technology or policy frameworks, but on addressing fundamental infrastructure needs, building technical capacity, securing sustainable funding models, and creating appropriate regulatory environments. Countries that can address these interconnected challenges holistically will be better positioned to leverage satellite technology for improved connectivity and digital inclusion.

Similarities

- Electricity access in remote areas is a common challenge particularly in Kenya, Indonesia and South Africa.
- Funding constraints for long-term programmes.
- Technical expertise limitations for complex satellite systems.

Differences

- Brazil focusing on managing spectrum to consider multiple constellations.
- Indonesia facing unique archipelagic geography challenges.
- Kenya emphasis on community engagement models.

Table 12: Country-specific solutions to satellite connectivity barriers

Country	Key solutions to barriers
Brazil	– Multi-source funding for public connectivity programmes (GESAC/Wi-Fi Brasil), leveraging both government and private sector resources; – Flexible contracting by Telebras, allowing the use of capacity from multiple satellite providers; – Technology transfer and domestic capacity-building through SGDC satellite projects; – Regulatory sandbox to test innovative business models and technologies.
Indonesia	– Large-scale public-private partnership (SATRIA) for high-throughput satellite deployment; – International financing to support satellite projects (e.g. AAIB - Asian Infrastructure Investment Bank); – Regulatory reforms to streamline licensing and allow more foreign participation; – Subsidized connectivity for public service points in remote areas; – Requirements for local infrastructure (e.g., network operation centres) to address digital sovereignty.

Table 12: Country-specific solutions to satellite connectivity barriers (continued)

Country	Key solutions to barriers
Kenya	– Implementation of regulatory sandboxes: The regulator established a Framework for Emerging Technologies Regulatory Sandbox, allowing the testing of new satellite applications under controlled conditions to foster innovation. – Sector-specific public-private partnerships: Implementation of direct collaborations between the education network (KENET) and private LEO satellite providers to connect remote university campuses without waiting for government procurement cycles. – Satellite backhaul for mobile expansion: Commercial integration of satellite backhaul into standard mobile network planning (e.g., Safaricom/Intelsat), allowing the extension of 4G coverage to rural areas where terrestrial backhaul is cost-prohibitive. – Targeted universal service fund (USF) usage: Utilization of the USF to finance specific capital and operational costs for connecting public schools in arid and semi-arid regions where no commercial case existed.
Nigeria	– Strong commitment to domestic satellite capability (NIGCOMSAT) while partnering with global LEO providers (OneWeb/Eutelsat); – Universal Service Provision Fund (USP Fund) to subsidize rural connectivity and support local manufacturing of equipment; – Direct-to-customer licensing for foreign operators, increasing last-mile access options.
South Africa	– Integration of satellite into the SA Connect Phase 2 programme, targeting rural households with affordable Wi-Fi hotspots using satellite backhaul; – Industry-government dialogue on alternative compliance with Black Economic Empowerment (BBEE) requirements; – Partnerships with global satellite providers (e.g., OneWeb/Skywire) for rural connectivity pilots.

4. Key lessons learned

The analysis of satellite telecommunication implementation in the five countries, Brazil, Nigeria, Kenya, Indonesia, and South Africa reveals several valuable lessons that can inform future policy development:

1) **Balanced regulatory frameworks are essential:** effective regulation must adapt to technological advancements while ensuring fair competition and public interest. The most successful satellite implementations occur when countries maintain regulatory frameworks that provide both certainty for operators and flexibility to adapt to technological change.

   - Brazil exemplifies this approach through ANATEL Resolution 748/2021, which updated the satellite licensing framework to accommodate NGSO (Non-Geostationary Satellite Orbit) constellations while maintaining clear operational requirements. The introduction of regulatory sandboxes in 2024 further demonstrates Brazil's commitment to innovation while preserving oversight mechanisms. This balanced approach has attracted multiple satellite operators while ensuring compliance with national telecommunications objectives.
   - Kenya's experience illustrates the challenges of balancing openness with incumbent protection, as evidenced by the formal protests from established operators and proposed increases in licensing fees.
   - Indonesia demonstrates thoughtful regulatory evolution through its Risk-Based Business Licensing system implemented in 2021, which streamlined procedures while relaxing foreign ownership restrictions for satellite communication services. This reform enabled more efficient market entry while maintaining essential regulatory controls. The requirement for local network operation centres represents a calibrated approach to digital sovereignty concerns without completely blocking foreign investment.

2) **Digital sovereignty concerns must be keenly addressed:** digital sovereignty concerns are inevitable as foreign satellite operators gain market share, requiring proactive policy frameworks rather than reactive measures. Hybrid models combining domestic assets and regulated foreign partnerships best address sovereignty risks.

   - Nigeria demonstrates the importance of maintaining domestic satellite capability through NIGCOMSAT operation of NigComSat-1R, while simultaneously partnering with international providers such as OneWeb/Eutelsat. This dual strategy preserves national control over critical communications infrastructure while leveraging global technology advances.
   - Indonesia has developed perhaps the most comprehensive approach to digital sovereignty through multiple mechanisms: requiring local NOCs for foreign satellite operators, maintaining significant domestic satellite capacity through SATRIA-1 (150 Gbit/s), and planning SATRIA-2 for additional national coverage. This multi-layered strategy allows Indonesia to benefit from global satellite services while maintaining critical infrastructure under national control.

3) **Public-private partnerships (PPPs) offer sustainable implementation models:** PPP structures have proven effective in scaling satellite connectivity. The most successful large-scale satellite deployments leverage PPPs that combine government objectives with commercial efficiency and innovation.

- South Africa's SA Connect Phase 2 illustrates comprehensive PPP integration, planning to connect 5.5 million rural households via Wi-Fi hotspots over three to four years. The programme combines government funding with private sector expertise to deploy satellite backhaul for extremely remote locations, providing affordable access (R5 per day for 1GB of data).
- Brazil's GESAC/Wi-Fi Brasil programme demonstrates effective public-private collaboration through Telebras role as a satellite integrator. The 2023 contract upgrade allowed

Telebras to contract capacity from multiple satellite operators beyond just the government SGDC satellite, creating flexibility and competition. This multi-source approach, combined with diverse funding streams (ministry budget, parliamentary amendments, and inter-ministerial agreements), has connected over 12 000 points nationwide and plans to add 20 000 schools through "Novo GESAC."

- Nigeria's partnerships with international providers such as OneWeb/Eutelsat complement its domestic satellite operations, while the collaboration with Hotspot Network Limited aims to reduce rural unconnected populations from 61 per cent to below 20 per cent by 2027.

4) **Complementary infrastructure investment is essential:** satellite deployment alone cannot solve connectivity challenges; success requires coordinated investment in complementary infrastructure, particularly electricity access and terrestrial networks. Satellites must be part of multi-technology strategies that include energy, fibre, and local access networks.

    - South Africa's SA Connect Phase 2 recognizes this challenge by incorporating satellite technology into a comprehensive connectivity strategy that includes optical fibre, mobile, Wi-Fi, and satellite technologies. Rather than treating satellite as a standalone solution, the programme views it as part of an integrated approach to universal access.
    - Indonesia's archipelagic geography compounds this challenge across over 17 000 islands, where irregular electricity distribution limits satellite terminal effectiveness.
    - Brazil integrates satellite connectivity with fibre backbones in the Amazon, ensuring hybrid connectivity for remote regions.

5) **Local capacity development ensures long-term sustainability:** countries that invest in domestic technical capacity and knowledge transfer achieve more sustainable satellite programmes than those relying solely on foreign operators and technology. Building technical expertise and manufacturing capabilities is critical and continuous investment in education, training, and local industry prevents dependency on external providers.

    - Kenya's delay on plans to launch a national satellite in 2025 due to funding and technical capacity constraints is evidence of this. The country is partnering with ITU to train regulators on spectrum management and universal service fund administration, addressing skill gaps.
    - Brazil maintains technical capacity through Telebras continuing role in satellite operations and integration, preserving institutional knowledge while contracting services from multiple operators. This approach maintains national technical capability while benefiting from international innovation and competition.
    - Nigeria struggles with delayed satellite replacements due to technical capacity gaps, highlighting the need for ongoing investment in domestic expertise. The delay in replacing NigComSat-1R highlights how capacity constraints can create vulnerabilities in national satellite programmes.

5. Conclusions

This report covering satellite communications practices across Brazil, Indonesia, Kenya, Nigeria, and South Africa reveals both the transformative potential of satellite technology for digital inclusion and the complex policy challenges that governments must navigate to realize this potential.

Main findings

The study demonstrates that satellite technology has emerged as a critical component of universal connectivity strategies across all five countries, with each nation developing distinct approaches tailored to their unique geographical, economic, and political contexts.

Brazil has achieved the largest satellite subscriber base through effective public-private partnerships and regulatory flexibility to enable market entry, while maintaining concerns about digital sovereignty due to market concentration. Indonesia's SATRIA-1 project exemplifies successful large-scale public-private collaboration, connecting 50 000 public service points across its archipelagic geography. Kenya has demonstrated regulatory agility in embracing new technologies. Nigeria maintains a balanced approach combining domestic satellite capability through NIGCOMSAT with strategic international partnerships. South Africa integrates satellite technology into comprehensive connectivity strategies while navigating complex transformation requirements.

All countries show similar patterns in their regulatory evolution, moving toward technology-neutral frameworks that accommodate both traditional geostationary and emerging non-geostationary satellite systems. Public-private partnerships have proven essential for successful implementation, combining government policy objectives with commercial efficiency and innovation. The focus on connecting public facilities, particularly schools and healthcare centres, has emerged as a practical and effective approach across all jurisdictions.

Key challenges

Four primary challenges emerge consistently across the surveyed countries. **Affordability and funding constraints** represent the most significant barrier, with satellite Internet costs remaining high relative to average income, expected particularly in rural areas where services are most needed. Even with competition and technological advances, monthly subscription costs and terminal equipment prices often exceed what many communities can sustainably afford without ongoing subsidies.

Digital sovereignty and market concentration concerns have intensified as foreign satellite operators gain substantial market share. Governments face the challenge of balancing the benefits of advanced global technologies with concerns about dependency on external providers and potential risks to national digital infrastructure control.

Infrastructure gaps, particularly reliable electricity access in remote areas, significantly limit the effectiveness of satellite deployments. This challenge is compounded by difficulties in securing skilled technical personnel for installation, maintenance, and ongoing support of satellite systems in remote locations.

Technical expertise limitations affect all aspects of satellite programme implementation, from regulatory oversight to system operation and maintenance. Countries currently find it difficult to develop and retain specialized knowledge in satellite engineering, spectrum management, and network operations, requiring capacity building efforts to ensure long-term sustainability.

Recommendations

Based on the comparative analysis and lessons learned from successful implementations, several key recommendations emerge for governments seeking to expand satellite connectivity in underserved areas.

Develop balanced regulatory frameworks that provide certainty for investors while maintaining flexibility to adapt to technological change. Countries should implement technology-neutral licensing approaches that accommodate both traditional and emerging satellite technologies, establish clear but streamlined authorization processes, and create regulatory sandboxes for testing innovative service models. Regular stakeholder consultations and adaptive policy mechanisms ensure frameworks remain relevant as technologies evolve.

Implement comprehensive affordability strategies through multiple mechanisms including government subsidies for public institutions, bulk purchasing agreements to secure better pricing, equipment financing or leasing programmes, and targeted support for low-income communities. Countries may consider integrating satellite connectivity costs into education and health ministry budgets to ensure sustainability beyond initial deployment phases.

Address digital sovereignty concerns proactively through hybrid models that combine regulated foreign partnerships with domestic capacity building. This may include requirements for local infrastructure components, partnerships with domestic operators, investment in national technical expertise, and development of contingency plans for service continuity. Countries should balance openness to international investment with strategic control over critical infrastructure.

Invest in complementary infrastructure and capacity development to maximize the effectiveness of satellite deployments. This includes coordinated investment in rural electrification, development of local technical expertise through training programmes, establishment of equipment supply chains, and creation of community engagement mechanisms to ensure services meet local needs and achieve sustainable adoption.

Leverage international cooperation and knowledge sharing to address common challenges more effectively. Countries can benefit from regional coordination platforms for sharing experiences and best practices, standardized analytical frameworks for programme evaluation, technical assistance programmes focused on capacity development, and coordinated approaches to negotiations with global satellite operators.

The evidence from these five countries demonstrates that satellite technology can significantly accelerate progress toward universal connectivity when supported by appropriate policy frameworks, adequate funding mechanisms, and sustained commitment to addressing implementation challenges.

Success requires viewing satellite services not as standalone solutions but as integral components of comprehensive digital inclusion strategies that address infrastructure, affordability, capacity, and sustainability challenges holistically. With thoughtful policy design and international cooperation, satellite technology can play a transformative role in connecting the world's remaining unconnected populations.

Annex I – Checklist for government agencies promoting the use of satellite services to connect underserved communities

This checklist provides government agencies with a structured framework to promote satellite connectivity for public service institutions and underserved areas. It distinguishes two strategic approaches:

1. Leveraging private satellite services;
2. Utilizing government-owned or state-supported satellites.

Each approach has unique regulatory, financial, and operational considerations to ensure sustainability, affordability, and efficiency.

1. General checklist for both strategies

Regardless of whether private or public satellite services are used, the following core factors should be assessed:

A. Policy and regulatory framework

- Legal Authority – Ensure telecommunications laws explicitly allow for satellite broadband deployment in public service institutions.
- Licensing Process – Define a streamlined process for satellite service providers, including landing rights, spectrum allocation, and ISP licences.
- Spectrum Management – Assign appropriate satellite spectrum (e.g., Ka-band, Ku-band, LEO-specific bands) and ensure coordination with terrestrial services. Access to spectrum is key to enable competition among satellite providers.
- Technology Neutrality – Allow hybrid connectivity models, integrating satellite with other technologies where applicable (fibre + satellite, mobile backhaul via satellite, satellite Wi-Fi zones).
- Universal Service Integration – Amend Universal Service Fund (USF) policies to subsidize satellite where terrestrial solutions are not feasible or too expensive.
- Consumer Protection and quality of service (QoS) – Define realistic speed, latency, uptime, and fair-use requirements.

B. Financial and sustainability considerations

- Cost Analysis – Compare costs of satellite services vs. terrestrial expansion for different areas, considering a reasonable timeframe and realistic estimate of resources to be allocated.
- Affordability Measures – Ensure subsidies, financing, or bulk purchasing models to make service accessible to low-income communities.
- Multi-Year Funding Commitment – Secure public or private funding for at least 5–10 years to sustain operations beyond initial deployment.
- Private Sector Incentives – Consider tax incentives, import duty exemptions for satellite equipment[104], or public-private partnership (PPP) models.

[104] Tax incentives for terminal devices increase network effects of getting connected, making connectivity more valuable and potentially increasing demand.

C. Implementation and site deployment

- Needs Assessment – Identify unserved communities and priority sites (schools, clinics, public offices, disaster response centres). Define technical requirements to address the corresponding needs.
- Site Readiness – Ensure power supply (solar or grid), local technical support if needed[105].
- Security Plan – Implement protections against theft, damage, and vandalism, with local community involvement.
- Training and Digital Literacy – Provide staff training at schools, clinics and other government agencies to maximize effective use of connectivity.
- Community Engagement – Conduct awareness campaigns to ensure public support and promote adoption of the new services.

2. Strategy-specific checklists

Criteria vary depending on whether the government partners with private satellite operators or deploys its own satellites.

A. Checklist for governments using private satellite services

This strategy involves contracting with private operators.

1. Contracting and public procurement

- Competitive Bidding Process – Conduct a transparent Request for Proposal (RFP) with clear evaluation criteria (cost, coverage, QoS, capacity).
- Bulk Capacity Purchase – Negotiate discounted rates via bulk purchasing of bandwidth for schools, health centres, and rural areas.
- Infrastructure Sharing Agreements – Encourage private satellite ISPs to interconnect with local Internet service providers (ISPs) or mobile network operators (MNOs) for hybrid service models.
- Landing Rights and Gateway Access – Ensure local ground station agreements are in place for low-latency services (particularly for LEO constellations), if needed.
- Public-Private Partnership (PPP) Structure – Define cost-sharing models, service duration, and maintenance obligations.

2. Pricing and affordability

- Subsidized Equipment and Installation – Ensure user terminals (VSATs, dishes) are available at reduced or zero cost for public institutions.
- Government Bulk Subscription Plans – Establish long-term contracts with providers for fixed monthly bandwidth costs (avoid market price fluctuations).
- End-User Tariff Regulation – If satellite ISPs serve households, consider regulating pricing fairness in rural areas vs. urban centres to prevent potential higher prices charged in rural areas.

[105] Local technical support required to set up and maintain local wireless networks, e.g. if satellite is used to provide connectivity through Wi-Fi networks.

3. Quality of service (QoS) and compliance

- Speed and Latency Guarantees – Define minimum performance (e.g., 10 Mbit/s for schools, 4 Mbit/s for households).
- Availability Standards – Consider requiring uptime requirements depending on the type of government agency served (e.g. uptime of at least 95–98 per cent for critical sites such as large schools and hospitals).
- Fair Use Policies (FUP) Transparency – Ensure ISPs clearly disclose any bandwidth caps or throttling practices.
- Ongoing Performance Audits – Conduct periodic checks to ensure service delivery meets contracted commitments.

4. Regulatory incentives for satellite ISPs

- License Fee Reductions – Offer fee waivers or reductions for satellite ISPs connecting priority areas.
- Duty-Free Equipment Imports – Waive import taxes on VSAT terminals, routers, antennas for rural deployments.
- Universal Service Fund (USF) Rebates – Allow satellite providers to claim USF subsidies for unprofitable but necessary coverage zones.
- Spectrum Fee Exemptions – Lower or waive spectrum fees for providers that serve remote, unconnected areas.

B. Checklist for governments using state-owned satellites

If the strategy involves a government-owned satellite (e.g., Brazil's SGDC, Indonesia's SATRIA, Nigeria's NigComSat, Argentina's ARSAT).

1. Satellite procurement

- Project Structure: Plan entire procurement process in advance, including a Request for Information (RFI) to engage industry players as soon as possible and a negotiation phase to better allocate public funds.
- Terms of Reference (TOR): TOR should be well structured, including for example objectives, background, submission process and timing, technical requirements and specifications, evaluation methodology and selection criteria, legal requirements, key contractual clauses, other terms and conditions.

2. Satellite system management and operation

- Ownership and Governance Model – Determine if the satellite is managed by:
  - A government entity (e.g., Telebras in Brazil).
  - A public-private joint venture (e.g., Indonesia's SATRIA PPP).
  - A fully commercial state operator (e.g., Nigeria's NigComSat).
- Technical Capacity and Ground Infrastructure – Ensure availability of teleports, network operation centres, and local expertise to manage the system.
- Backhaul and Integration with Terrestrial Networks – Plan fibre interconnection points for better bandwidth distribution.

3. Service deployment and subsidized access

- Identify Priority Public Sector Users – Allocate dedicated capacity for education, healthcare, government, and emergency services.
- Free or Discounted Public Service Plans – Set policies for free bandwidth quotas for schools and hospitals, with paid commercial options for sustainability.
- Government as an Anchor Tenant – Commit public sector users (e.g. military, research, education, others) to pre-purchase capacity for long-term viability.

4. Financial sustainability and risk management

- Revenue Generation Plan – Develop a commercial model to sell excess capacity to telcos, businesses, or international partners.
- Cost Recovery Mechanism – Implement a tiered pricing model: subsidized for social services, commercial rates for other users.
- Backup and Redundancy Plan – Ensure multi-satellite coverage agreements in case of service failure or satellite degradation.

5. Performance monitoring and policy adaptation

- Annual Public Reports – Publish transparency reports on satellite usage, cost efficiency, and coverage expansion.
- Impact Assessment Studies – Evaluate improvements in education, healthcare, and economic development from satellite access.
- Upgrade and Expansion Planning – Set a timeline for future capacity expansion or next-generation satellite deployment.

3. Long-term strategy and continuous improvement

- Establish a permanent satellite connectivity task force within the telecommunication regulator to monitor the development of connectivity needs and adjust strategy over time.
- Participate in regional satellite policy harmonization.
- Develop local satellite technology expertise through university partnerships and workforce training.
- Adapt policies to satellite technology development.

Annex II – Trade-offs between private and government-owned satellites and decision-making roadmap

Governments deciding how to expand satellite connectivity must weigh up cost, control, efficiency, and long-term sustainability.

The choice between using private satellite services or investing in a government-owned satellite comes with trade-offs:

Factor	Private satellite services	Government-owned satellites
Upfront Investment	Low to none (private sector funds infrastructure)	High (government must fund satellite design, launch, and ground infrastructure)
Time to Deploy	Rapid (existing satellites can provide service immediately)	Slow (takes 5–7 years to develop, launch, and operationalize)
Service Costs	Subscription-based, with potential bulk discounts for governments	Lower long-term costs, but high initial capital expenditure
Control and Sovereignty	Limited[106] (private companies own and operate the network)	Full control (government decides usage, pricing, and security policies)
Flexibility	High (multiple providers available, easy to switch services)	Low (government is locked into its own satellite capabilities)
Technical Complexity	Minimal for government (outsourced to private firms)	Requires government to develop in-house satellite expertise
Market Competition	Encourages competition, driving better service and pricing	Government monopoly may limit innovation and efficiency
Integration with National Policies	Requires regulatory oversight to ensure coverage priorities	Can be designed to align directly with national connectivity goals
Sustainability and Maintenance	Private operators can typically handle upgrades and replacements	Government must fund future satellites or risk service disruptions

Decision-making roadmap: private vs. government-owned satellites

To determine the best approach, governments should follow a structured decision-making process:

Phase 1: Needs assessment

- Map coverage gaps – Identify underserved areas, priority institutions (schools, hospitals, public offices), and expected bandwidth demand.
- Evaluate market availability – Assess whether private satellite providers already offer service in targeted areas.

106 This can be counterbalanced by regulatory requirements that facilitate market entry and enforcement mechanisms to monitor compliance.

- Assess budget constraints – Determine whether the government has the financial resources for a long-term satellite investment or if leasing capacity is a better short-term option.

Phase 2: Cost-benefit analysis

- Compare total costs over 10–15 years
    - Private Satellite Model: Analyse subscription pricing, potential government bulk discounts, long-term service contracts.
    - Government-Owned Model: Assess the total lifecycle cost (satellite manufacturing, launch, operation, maintenance, and replacement costs).
- Assess technical and administrative capacity
    - Assess if there is sufficient and qualified local expertise to manage a government-owned satellite.
    - Assess the necessity for a public-private partnership to cover operations' costs and requirements.

Phase 3: Policy and Regulatory Planning

- If choosing private services:
    - Develop a regulatory framework for licensing, QoS, and service pricing.
    - Negotiate landing rights, local gateway access, and universal service obligations with satellite ISPs.
- If choosing a government-owned Satellite:
    - Secure funding sources (government budget, international loans, PPPs).
    - Establish an agency or task force to oversee satellite procurement, deployment, and management.

Phase 4: Implementation

- If using private services:
    - Begin pilot projects with contracted satellite providers.
    - Evaluate and expand based on service quality and adoption rates.
- If deploying a government satellite:
    - Initiate satellite manufacturing and launch process (typically a three to five-year timeline).
    - Develop ground station infrastructure and operational teams.

Phase 5: Long-term strategy and sustainability

- Evaluate performance: Continuously monitor QoS, affordability, and user adoption.
- Adjust strategy:
    - If private satellite contracts become too expensive or unreliable, revisit government ownership.
    - If a government satellite is inefficient or underutilized, consider opening capacity to commercial users.

Conclusion: choosing the best model

- Consider private satellite services if rapid deployment, low upfront costs, and flexibility are priorities.
- Consider investing in a government-owned satellite if long-term control, national security, and policy-driven connectivity are key concerns.
- Hybrid Models are also a consideration. Some countries choose to lease private capacity for immediate needs while planning long-term state satellite programmes.

Governments should periodically reassess their satellite strategy to ensure it aligns with evolving connectivity needs, technological advancements, and financial sustainability.

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