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Bridging Digital Divide Gaps Among Developed and Developing Nations for Free Intercontinental Information Flow & Access

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A global information environment of the 21 st century can be characterized by a fundamental and enduring paradox: although digital technologies have introduced unprecedented opportunities to create, share and access knowledge on a scale never conceived before, the positive outcomes of the digital revolution are heavily, structurally and persistently unevenly distributed among countries, regions, communities and even demographic groups. According to the International Telecommunication Union (ITU) Facts and Figures 2024, the number of people who are now online, 5.5 billion, or 68% of the world population, is estimated, but 2.6 billion people, one-third of humanity, are still completely offline, and the most significant disparities are in low-income nations, rural regions, and women. This digital divide: the difference between access to and meaningful use of digital technologies and internet connectivity in developed and developing countries is one of the most impactful sources of global information inequality of our time, with systematic effects on the free flow of information across continents and the continued cycles of educational marginalisation, economic exclusion, and social disadvantage that undermine the sustainable development ambitions of the global community. The paper will be a thorough, theoretically sound, and empirically rigorous analysis of the digital divide between developed and developing countries. It explores the internet concept as global interconnectivity architecture; explores the varying digital realities of developed and developing countries with current statistical evidence; outlines the nature, scale, theory of digital divide; assesses present and future strategies to bridge the connectivity gaps, such as investing in infrastructure, affordable access programmes, developing digital literacy, satellite internet technology (Starlink and LEO constellations), and international development coalitions; critically evaluates the The paper is structured around eight substantive sections, supported by five tables, two schematics, and a comprehensive reference list of peer-reviewed and institutional sources from 2019–2025.

Keywords: Digital Divide, Internet Access, Developed Nations, Developing Nations, Information Flow, ICT, Global Village, Connectivity, Information Equity, Nigeria, Starlink, Broadband, Digital Literacy, SDGs

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INTRODUCTION

The 21st century is the era of the information society the epoch when knowledge, data, and the digital connection are the main sources of economic productivity, social engagement, education, and democratic rules. The Roadmap of Digital Cooperation by the United Nations Secretary-General (2020) confirmed that internet connectivity has ceased to be a luxury, but a basic facilitator of human progress, declaring universal, affordable, and meaningful internet connectivity a

global priority over the next decade. This dream however is faced by a harsh reality: in 2024, 2.6 billion individuals, or the total population of Africa, Latin America, and most of southeast Asia, will still have no connection to the internet at all (ITU, 2024; DISD-UN, 2024). The digital divide, the gap between those who have access to digital connectivity and those who do not, has become more of a qualitative gap as it continues to decrease in pure access figures, with 5G networks, artificial intelligence (AI) applications, and data-intensive digital services increasing the capability disparity between connected and unconnected populations.

To information professionals, librarians, and library and information science (LIS) scholars, the digital divide is not just a technological or economic phenomenon, but it is a problem of information access inequity. The very democratic notion of the library, the accessibility of all the knowledge of humanity, is structurally compromised when billions of individuals are unable to access the digital repositories, databases, e-journals, open-access platforms, and information ecosystems that have become the major sources of spreading knowledge on the planet. Van Dijk (2020) suggests that digital inequality replicates and exacerbates pre-existing inequalities of offline inequality into compounding cycles of disadvantage that are becoming harder to undo. The UNCTAD World Summit on the Information Society (WSIS) Annual Review 2023 cautioned of a risk that the data economy will become permanently dominated by a small group of stakeholders in a few technologically advanced economies- a possibility that will institutionalise informational dependency and cement the position of developing nations at the bottom of the global knowledge order (UN Press, 2023).

In this paper, this is a critical challenge that is dealt with with the urgency and explanatory nature it requires. It builds upon the latest information provided by the ITU, World Bank, Nigerian Communications Commission (NCC), GSMA, the Mo Ibrahim Foundation, and peer-reviewed literature to create a comprehensive analysis of the worldwide digital divide, the factors influencing it, the measures that are currently being implemented to address it, and the potential of transformative digital inclusion that would truly allow free intercontinental information flow and access. Nigeria, the country with the largest internet user base in Africa, 163 million users (Development Aid, 2024) but still lagging by a wide margin behind its national broadband goals, provides a case study throughout the paper to demonstrate the challenges and opportunities of bridging the digital divide in a large, complex developing country.

Theoretical Grounding: Key Frameworks

This paper is informed by three major theoretical frameworks. To begin with, the Sequential Model of Digital Access by Van Dijk (2006, 2020) that distinguishes four sequential barriers to meaningful digital participation: motivational access (desire to use ICT), physical/material access (having devices and connections), skills access (digital literacy and competency), and usage access (actual meaningful use). This model points out that connectivity provision, not dimensioned to motivation, literacy, and meaningful use, will not help to bridge the digital divide. Second, the Capability Approach by Amartya Sen (1999) when applied to the digital context by other scholars, like Kleine (2013), which defines digital access as a form of capability expansion: digital technologies are not important in themselves but serve as a means of enhancing human capabilities, such as education, economic, health, political, and self-determination. Third, the Information Poverty Theory (Chatman, 1996; Al-Zaman, 2023), according to which information poverty or the condition of perpetual lack of access to information that other members of society can assume as normal is a cause and effect of overall social and economic poverty. In this framework, digital exclusion is information poverty that has systemic impacts on human development.

Table 1: Theoretical Frameworks Applied to the Digital Divide

Theory / Framework	Key Propositions	Application to Digital Divide
Van Dijk's Sequential Digital Access Model (2006, 2020)	4 sequential access barriers: motivational, physical, skills, usage	Connectivity alone insufficient; must address motivation, literacy, and meaningful use simultaneously
Sen's Capability Approach (1999); Kleine (2013)	ICT matters instrumentally as a capability enhancer, not intrinsically	Digital inclusion must be evaluated by whether it expands substantive human freedoms—education, health, economic participation
Information Poverty Theory (Chatman, 1996; Al-Zaman, 2023)	Information poverty = chronic exclusion from socially normalised information access	Digital exclusion = information poverty; compounding cycles of disadvantage reinforce inequalities

Continuation of Table 1

Diffusion of Innovations (Rogers, 2003)	Innovations diffuse through social systems; adopters range from innovators to laggards	Digital technologies diffuse fastest in high-income, high-literacy contexts; structural barriers slow diffusion in developing nations
ICT4D Theory (Heeks, 2020; Bon et al., 2024)	ICT for development must be human-centric, not technology-push; grassroots ownership matters	Bridging strategies must address local needs, cultural contexts, and community ownership—not merely technology deployment

Table 1: Author's Synthesis (2024); adapted from Van Dijk (2020); Sen (1999); Chatman (1996); Al-Zaman (2023)

CONCEPT OF THE INTERNET: INFORMATION INTERCONNECTIVITY OF NATIONS AND THE GLOBAL VILLAGE

The Internet as Global Information Architecture

The Internet is a universally distributed, decentralized system of interconnected computer networks, based on standardised communication protocols (mostly Transmission Control Protocol/Internet Protocol: TCP/IP), and is the greatest and most far-reaching experiment that mankind has made in the interconnectedness of information. The internet was originally designed as a strong, distributed communication network in 1969 by an agency of the United States Department of Defense called the Advanced Research Projects Agency, which envisioned the internet as a network which could withstand partial failure of infrastructure (which was called ARPANET). Its commercial and public introduction in the early 1990s, with the invention of the World Wide Web (19891991) by Tim Berners-Lee, changed it into a world-wide information infrastructure that has radically restructured human communication, business, education, government, and culture.

The Internet has fulfilled what the most fully realised prophecy was made in communications technology, the so-called Global Village (1964) by Marshall McLuhan, whereby the communications technology collapses space and time to form a single, shared global information space. McLuhan believed that electronic media (radio, television, and what he predicted would be interactive global networks) would revert the discontinuity of human experience presented by print culture, and establish a novel form of global simultaneous awareness and interdependence. The modern Internet, which allows instant, multimedia, interactive, many-to-many, global communication at nearly zero marginal cost, is even more extensive and ambiguous than McLuhan imagined it would be and has not only created novel possibilities of sharing knowledge all over the globe, but has introduced new modes of cultural homogenisation, surveillance, manipulation, and inequality.

The internet is a phenomenon of more than just mere application to libraries and information professionals: it forms the basic infrastructure of the modern knowledge society. The potential of the internet to fulfil the promise of universal access to the accumulated knowledge of humanity, embodied in the Five Laws of Library Science (1931), especially his fifth law (The library is a growing organism), and his vision of information access as a universal right can in principle be made actual. Nevertheless, with the organization of online information according to market forces, language dominance, and algorithmic mediation, as Mattelart (2008) and literature in information inequality document, universal access continues to be a dream but not a reality of the billions of people around the globe (ScienceDirect, information inequality; Al-Zaman, 2023).

The Internet as Development Infrastructure

The internet access has increasingly become a human development requirement by the United Nations. A historic report to the Human Rights Council in 2011 by UN Special Rapporteur Frank La Rue stated that the right of access to the internet was a human right under the Universal Declaration of Human Rights (freedom of expression) in Article 19 of the Constitution and gave a positive obligation to the state to enable access to the internet and a negative obligation against limiting access to the internet. Operationised through SDG 9 (Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation) under the Sustainable Development Goals (SDGs) of the UN, which was adopted in 2015, this recognition is to be met through SDG 9.c, which states that by 2020, countries are expected to have significantly increased access to information and communications technology and work towards the goal of universal and

The importance of the internet connection in developing countries is empirically proven to have economic importance. The GSMA Mobile Economy Sub-Saharan Africa 2023 report records that mobile technologies added US$140 billion to GDP in Sub-Saharan Africa in 2023, and recommends that this can grow by US$30 billion in response to the reduction of

key barriers to connectivity (Developing Telecoms, 2025). A study conducted by the World Bank estimating the effect of a 10 percentage-point rise in the broadband penetration rate found GDP growth effects of around 1.38 in high and 1.12-1.21 in middle and low-income countries, proving connectivity to be a development outcome and a development driver with significant positive externalities (World Bank, 2022). In the case of Nigerian universities, in particular, access to the global academic databases, the possibilities of international research cooperation, and e-journals of the NUC Virtual Library (95,000+) are all defined by internet connectivity, which academics in academically disconnected universities can structurally access.

DEVELOPED COUNTRIES AND INTERNET ACCESS: THE CONNECTED WORLD

Statistical Profile of Developed-World Connectivity

The developed countries, generally with high per capita incomes (World Bank high-income threshold: >13,845 GNI per capita in 2023), post-industrial economies, high education and human development index (HDI) scores, and with institutionally robust governance systems, are the largest adopters of the internet by all available measures. The internet is used by around 90 percent of the population in Europe, the Commonwealth of independent states and the Americas (ITU, 2023). In more specific terms, the penetration in Northern Europe is 97.4, North America 96.9, and Western Europe 93 -95. The ITU Facts and Figures 2024 establishes that in the group of high-income countries, 93% of the population were estimated to be using the Internet in 2024 (ITU, 2024; UAR-AUB, 2024).

The internet connectivity in the developed countries is also unique. In 2024, the average monthly mobile broadband traffic per subscription in high-income countries was 16.2 GB eight times more than the 2 GB average in low-income economies (ITU, 2024). In the developed countries, the average fixed-broadband subscription per subscription has 257 GB per month in 2022 (ITU, 2023)- a usage rate that does not only signify access, but also profound, data-intensive digital use: 4K video streaming, cloud-based productivity, AI-powered applications, and high-bandwidth scholarly investigation. High-income countries had 84% of the population covered by 5G in 2024, with LTE (4G) approaching ubiquity, which is facilitating the mobile, cloud-based digital economy that is becoming the norm in these societies (ITU, 2024).

Countries that have the highest rates of internet penetration (as in Norway, Saudi Arabia and the UAE all at 99%), South Korea (98%), Japan and Denmark (97%), have attained near ubiquity by continued investment in national broadband plans, gradual universal service requirements, and competitive regulation of telecommunications markets and extensive digital literacy programmes (DevelopmentAid, 2024). South Korea and Estonia (the latter is often called the most digitalized society in the world) are often discussed as examples of purposeful, policy-oriented digital transformation that has integrated internet access into the very structure of all aspects of civic, economic, and educational activity.

Structural Advantages of Developed Nations in the Information Ecosystem

In addition to rates of connectivity, developed countries have structural advantages in the world information ecosystem that exacerbate the qualitative aspects of the digital divide. First, they carry the vast majority of the large data centres, cloud computing infrastructure (Amazon Web Services, Google Cloud, Microsoft Azure), content delivery networks (CDNs) and internet exchange points (IXPs) the physical backbone of the flow of information on the internet. Such a geographic concentration implies that information created in Africa, Asia, or Latin America may frequently need to be relayed to servers in North America or Europe to be processed and sent back- a technical latency that is indicative of underlying structural informational reliance. Second, the predominant language of global internet content is mostly English (52% of websites), Spanish, French, German, and Chinese, which are not the main languages of most developing-world internet users, posing a barrier to content accessibility that cannot be easily overcome by connectivity (Bon et al., 2024). Third, the data governance, intellectual property rights, and digital trade institutional frameworks, such as the EU General Data Protection Regulation (GDPR) and OECD digital trade principles, are mostly structured by and to benefit the developed world, often imposing compliance costs on the developing-country actors who may represent alternative cultural and regulatory settings (Imran, 2023).

DEVELOPING COUNTRIES AND INTERNET: CONSTRAINED CONNECTIVITY IN AN INEQUITABLE LANDSCAPE

The Scope of Connectivity Deficit in the Global South

The developing countries- with lower per capita incomes, agrarian or emerging industrialized economies, lower HDI ratings, and inconsistent governance institutions- have a much more limited digital environment. According to the ITU

2023 data, merely 37 percent of the African population was using the internet, as compared to 67 percent worldwide and about 90 percent in Europe and the Americas (ITU, 2023). Only 35 percent of the population in the Least Developed Countries (LDCs) of the world is estimated online in 2024, and in the Landlocked Developing Countries (LLDCs), the number is 39 percent - with country-by-country rates ranging from a low of 10.6 percent in the Central African Republic on the one end of the sub-Saharan distribution to a high of ITU estimates that out of the 2.6 billion individuals offline in 2024, 1.8 billion, or about 69% of this group, will reside in rural regions (DISD-UN, 2024; ITU, 2024).

The problem of connectivity gap is specifically unveiled in Sub-Saharan Africa. According to GSMA Intelligence, mobile internet penetration in Sub-Saharan Africa currently (at the end of 2023) was at a pitiful 27% and a truly astounding 60% of the sub-continental population had no connection (Developing Telecoms, 2025). Moreover, only 13% of the Sub-Saharan population has 4G networks, the minimum standard necessary to fully engage in the digital economy, and, therefore, physical coverage coverage, not just barriers to adoption, can be seen to be a major factor in this connectivity gap. The GSMA approximates that the mobile sector adds over 140 billion to the GDP of Sub-Saharan Africa, and over 30 billion in value could be unlocked in case the critical connectivity obstacles are alleviated.

Nigeria: Africa's Digital Giant with a Connectivity Deficit

The case of Nigeria is a good example of the intricacies of internet penetration in developing countries. Nigeria, being the most populous country in Africa (estimated population: 216.7 million in 2022, NPC), and the largest economy by nominal GDP, has the largest number of internet users in Africa as well: Nigeria has an estimated 163 million users (DevelopmentAid, 2024). But this absolute scale conceals important structural shortcomings. The percentage of the population with high-speed (>= 25 Mbps downlink) internet access, known as broadband penetration rate, stood at Nigeria at only 44.43% at the end of 2024 and 50.58% as of November 2025, which is far short of the expected 70% under the National Broadband Plan (NBP) 20202

According to the NCC Subscriber/Network Performance Report 2024, the contribution of the telecoms industry to the GDP in Nigeria increased to 14.4% in Q4 2024 (compared to 14.0% in Q4 2023) and this is a good sign that reflects the economic value of the sector. But the same report records that Nigeria faces serious structural issues: the broadband infrastructure of the country is largely based on mobile GSM networks (more than 99 percent of broadband connections are mobile), and the fixed-line broadband penetration is low; 43.53 percent of mobile connections are still on 2G networks as of late 2024; and fibre optic vandalism, averaged at 30 to In January 2025, the Centre for Information Technology and Development (CITAD) found that about 27 million Nigerians have no access to any telecommunications infrastructure that is more than the populations of many African countries.

The aspect of cost exacerbates the problem of connectivity in Nigeria. The current ITU statistics show that in 20232024, the average cost of an entry-level mobile broadband plan (2 GB/month) in Nigeria was 4.2 percent of GNI per capita that is more than 2 times higher than the affordability target of the UN Broadband Commission (2 percent of monthly income) (Borgen Project, 2025). Although mobile data has become much cheaper than it was at the beginning of the 2010s, it is still prohibitive to the vast segments of Nigeria with low-income levels, especially in rural settings, where income levels are lowest and connectivity infrastructure is poorest.

Table 2: Comparative Internet Access Profile — Developed vs. Developing Nations (2023–2024)

Indicator	High-Income Nations (2024)	Low-Income/Africa (2023–24)	Source
Internet penetration rate	93% (high-income)	27% (SS Africa mobile)	ITU (2024); GSMA (2023)
Mobile broadband traffic/month	16.2 GB/subscription	2 GB/subscription (LICs)	ITU (2024)
5G population coverage	84%	4% (low-income)	ITU (2024)
Fixed broadband affordability	<2% of monthly income	~33% of monthly income (LICs)	ITU (2024)
Urban internet access	~95%	83% global; <50% LICs rural	DISD-UN (2024)
Gender parity score (GPS)	~0.98 (near parity)	0.72 (Africa, 2024)	ITU Africa (2025)
Nigeria broadband penetration	N/A	44.43% (end-2024); 50.58% (Nov 2025)	NCC (2024); TechCabal (2025)
Nigeria 70% broadband target	N/A	TARGET MISSED (NBP 2020–2025)	MSME Africa (2025)

Table 2: Compiled from ITU Facts and Figures (2023, 2024); GSMA (2023); NCC (2024); TechCabal (2025); DISD-UN (2024); ITU Africa (2025)

DIGITAL DIVIDE: CONCEPT, DIMENSIONS, AND CONSEQUENCES

Definition and Evolution of the Concept

The digital divide is the difference in access and meaningful use of digital technologies (especially the internet and related digital information systems) among various demographic groups as well as geographic regions. It was coined in the United States in the mid-1990s to define the disparity between the group capable of affording a personal computer or mobile phone and the one unable to (DevelopmentAid, 2024; Bon et al., 2024). The concept has been gradually elaborated and expanded in its analytical focus over three decades, to include not just two poles of access/no-access, but a variety of dimensions of inequality in the character and quality of digital engagement.

The existing scholarship on digital divide, following the contributions of Van Dijk (2020), Helsper (2020), Warschauer (2004), and Imran (2023), identifies at least three different but interrelated levels of digital divide. The first-level gap is physical/material access, that is, whether people have access to digital devices (computers, tablets, smartphones) and internet connections that are of a high quality to support meaningful use. The second level gap is digital skills/use that is whether the people with physical access have the literacy, competencies and motivation to utilize digital technologies effectively to get an education, economic involvement, health, civic action and cultural expression. The third level separation is on the results of digital engagement: will digital interactions have real effects on the life quality, economic conditions, education, and social integration, as Van Dijk (2020) would describe as the inequality of appropriation.

The fourth and latest dimension that has been articulated (identified by ISPI (2025) and supported by ITU (2024)) is the AI and data divide: the new space between countries that are generating, owning, and monetizing artificial intelligence, data analytics, and digital platform technologies, and those that are major consumers of such technologies and often have minimal control over their own data. According to UNCTAD (2023) WSIS Report, the risk is that the data economy will become permanently polarised with a limited number of stakeholders in a limited number of technologically advanced economies, which, should this come to pass, would institutionalise a fourth-level digital divide with deep-seated consequences to the epistemic sovereignty and informational self-determination of developing countries (UN Press, 2023).

Multidimensional Consequences of the Digital Divide

The implications of the digital divide are not just technological but fundamentally developmental as it has an impact on all aspects of human capacity and social fairness. The digital divide has brought about systematic disadvantages in access to e-learning materials, online academic libraries (e.g., the NUC Virtual Library), digital textbooks, and international research outputs in education which are increasingly mediated by subscription-based, internet-dependent services. The UNESCO (2021) estimates that to connect all schools in the world to internet would cost 225 billion capital with 81% of this requirement being focused in low- and lower-middle-income countries, which is a figure that demonstrates the size of educational infrastructure investment that is necessary to bridge this aspect of the divide. These divides were revealed and magnified by the COVID-19 pandemic that forced the world to transition to online education: millions of students in developing countries are not only left out of further education due to the school closures alone but also due to connectivity exclusion (UNESCO, 2020; Grokipedia, 2026).

Digital divide limits access to the digital economy in economic development, the fastest-growing segment of the world economy. E-commerce, online financial services, gig economy, and online small business are not accessible to the population that lacks dependable connectivity, and the citizens of the developing world miss out on economic opportunities that are structurally accessible to their counterparts in connected countries. In its Future of Jobs Report 2023, the World Economic Forum estimates that by 2027, rising digital inequalities and accessibility may expose millions of workers in developing countries to structural unemployment due to automation and AI restructuring the labour market around the world. According to Development Aid (2024), digital literacy is now a prerequisite to enter the economy of the 21 st century that is comparable to the demands of reading and numeracy skills- a requirement that is currently not met by about 73% of adults in LDCs.

In access to information and equity in knowledge, the dimensions most directly applicable to library and information science, the digital divide has resulted in what Al-Zaman (2023) describes as information poverty on a large scale: the long-term marginalization of billions of individuals out of the information that defines educational, health, economic, and civic outcomes. The Data Poverty Index mentioned by Al-Zaman records the rates of information poverty in poor nations and the consequent information disparity in the world, where high-income nations have access to information on a vastly superior level. In the context of Nigerian university libraries and their communities, this information poverty is reflected most tangibly in inappropriate access to up-to-date research literature, a lack of capacity to engage in global scholarly communities, and a lack of capacity to produce and disseminate research outputs that gain global citation and visibility.

Table 3: Consequences of the Digital Divide Across Development Dimensions

Development Dimension	Impact of Digital Divide	Evidence / Data
Education	Exclusion from e-learning; unequal access to digital textbooks and research databases	UNESCO (2021): connecting all schools globally requires $225B; 81% needed in low/lower-middle income nations
Economic Development	Exclusion from digital economy; e-commerce; digital financial services; remote work	GSMA: $140B GDP contribution in SS Africa; $30B additional gain possible with better connectivity (GSMA, 2023)
Information Access (Libraries)	Research literature inaccessible; limited scholarly collaboration; low research output	Al-Zaman (2023): information poverty endemic in Global South; Nigerian university research output constrained by connectivity gaps
Healthcare	Limited telemedicine; poor access to health information; slow pandemic response	COVID-19 exposed healthcare informational divide; digital exclusion impedes mHealth adoption in rural Nigeria
Civic Participation	Limited access to e-government; reduced political information access; democratic exclusion	UN Press (2023): digital divide exacerbates inequalities in education and finance; limits democratic participation
Gender Equity	Women more likely to be offline; compound disadvantage in education, work, and information	ITU (2024): 70% men vs 65% women online globally; 189 million more male users; Africa GPS=0.72
AI & Data Economy	Developing nations become data-generating consumers but not data-owning producers	UNCTAD/WSIS (2023): risk of permanent data economy domination by handful of technologically advanced economies

Table 3: Author's Synthesis (2024); sources as cited

BRIDGING DIGITAL DIVIDE GAPS: STRATEGIES FOR FREE INTERCONTINENTAL INFORMATION FLOW

Infrastructure Investment and Universal Service Obligation

The long-term solution to the digital divide is long-term investment in digital infrastructure: the fibre-optic backbone networks, mobile tower networks, submarine cable systems, internet exchange points, and data centres which are the physical circulatory system of the internet. The international development agencies, such as the World Bank, African Development Bank, Asian Development Bank and European Investment Bank have developed various infrastructure funding initiatives designed to provide the developing countries with the understanding that private-sector investment will not be enough to access rural, low-income and commercially unviable locations. The World Bank Digital Development Partnership, the UN's ITU-UNDP Joint Facility to Global Digital Capacity (established 2021) and the EU Global Gateway program (€150 billion global infrastructure including digital, 20212027) are major multilateral initiatives towards connectivity infrastructure in developing countries (Grokipedia, 2026; ISPI, 2025

The National Broadband Plan 2020 2025 in Nigeria targets high-level aspects such as 70 percent broadband penetration, efficient coverage of 90 percent of the population, minimum download speeds of 25 Mbps (urban) and 10 Mbps (rural) and data affordability of not more than 390 Nokia per 1 GB. Although the 70% target of penetration was not achieved (Nigeria reached 44.43% at the end of 2024 and hit 50% in November 2025) the NBP has achieved considerable progress, such as the intended expansion of the Nigeria broadband backbone by 90,000 km of new fibre optic cables, Project These projects indicate that the infrastructure investment led by policy can propel connectivity development, although below initial expectations.

Affordable Access Programmes and Cost Reduction

Affordable-but-not-connective connectivity is merely connectivity. The affordability goal of the UN Broadband Commission on Sustainable Development (1 GB of mobile broadband data at no more than 2% of monthly per capita income) offers a quantifiable policy marker of affordability interventions in the developing world. According to the International Telecommunication Union data, as the cost of the internet access has become more affordable in many countries of the world, the price of a fixed-broadband subscription in the low-income countries is equivalent to almost a

third of average monthly income in 2024, which is a 15-fold difference compared to the ITU affordability standard (ITU, 2024; DISD-UN, 2 In Nigeria, the entry-level mobile broadband basket in 2024 was 4.2% of GNI per capita, which is above the affordability threshold, but was better in 2023 at 4.6% (Borgen Project, 2025).

Some approaches to enhancing affordability are: regulation of the telecommunications market to prevent monopolistic pricing; subsidies through the universal service fund to connectivity in low-served regions (the USPF in Nigeria); the development of community WiFi networks in rural and peri-urban regions; subsidy programmes on devices (like import tax exemptions on mobile devices and computers); subsidy of essential education and health content platforms; and regulation of prices The Alliance for Affordable Internet (A4AI) proposes a multi-faceted policy approach that would integrate these mechanisms to meet the Broadband Commission goal of 2% affordability of broadband in developing countries. Development Aid (2024) reports that the World Economic Forum estimates that enhancing education and reskilling due to the use of digital technologies could make the world GDP rise by US$8.3 trillion by 2030 a macroeconomic advantage that significantly surpasses the affordability intervention cost.

Digital Literacy and Skills Development

The Sequential Model created by Van Dijk (2020) confirms the existence of the usage divide that is perpetuated by physical access without skills access despite the technical connection between populations. Recent international surveys indicate that in least developed countries, only a quarter of the population have basic digital skills in 2023 - that is, in the countries where people have access to it, three-quarters of the population in the poorest countries of the world cannot use it effectively in 2023 (Grokipedia, 2026; ITU, 2024). Digital literacy programmes - including basic ICT skills, internet literacy, online safety and security, critical appraisal of online information, and useful use of digital tools to learn and participate in economic activities - are key complements to connectivity infrastructure investment.

Examples of successful digital literacy scale models are the National Digital Literacy Training Programme in South Korea (reaching millions of people per year); the Digital Finland Programme in Finland that has integrated digital literacy into all levels of education; and the Digital Saksharta Abhiyan (DISHA) in India that has trained rural population on digital literacy (5.25 million people). In Africa, digital skills training of women and youth in Nigeria, Kenya and other countries by UNITAR has been in operation since 2022 and has provided participants with the means to create bankable technological innovation, leading to more than 500 scaled community projects by mid-2025 (Grokipedia, 2026). In 2023, the IsDB created its Digital Inclusion Technical Working Group (IDITWG), which is currently designing a comprehensive Digital Inclusion Strategy of 57 member states, with skills upgrading being a key requirement to meaningful connectivity (World Economic Forum, 2022). In Nigeria, there is the Digital Literacy and Digital Inclusion Programme (DLIP) of the Federal Ministry of Communications and Digital Economy that aims to train one million people to fill the second level of the digital divide.

Satellite Internet Technology: Starlink and the LEO Revolution

The advent of Low-Earth Orbit (LEO) satellite internet constellations, which operate without going through any terrestrial infrastructure, by providing broadband services directly to the consumer terminals through space, has become one of the most potentially transformative technologies in closing the digital divide between remote and rural populations in developing countries. The most successful network in this new industry is SpaceX: its Starlink, which launched the first 60 satellites in May 2019, is now operational in more than 150 countries all across the globe, with 8,600+ satellites in orbit, over 7 million subscribers worldwide, and has been active in 23 African countries (Telegeography, 2025; Space In A

In Nigeria in February 2023 (the first African country to get the service), Starlink made its debut in Africa. The impact has been significant and complex. Starlink has provided fixed internet speeds of 100200 Mbps and a latency of 4060 ms in Nigeria, more than two times faster than the typical terrestrial internet speed of 2530 Mbps, and was the second-largest fixed internet provider in the country in two years, boasting more than 65,000 active users by Q3 2024 (E Nevertheless, the price of Starlink, which is a one-time hardware purchase of NGN318,000 ($216) and a monthly subscription fee of NGN57,000 ($39) as of 2025, is way outside the budget of the average rural Nigerian family, whose monthly earnings are estimated to be less than NGN28,000 ($60). Fortune Magazine (2023) reported that Starlink is cheaper in Nigeria than fibre optic and mobile internet providers, but is unaffordable to the very rural and low-income people who are most in need of a connectivity solution.

Other than direct consumer access, the most effective model of deployment of Starlink in Africa has been enterprise and infrastructure partnerships. In July 2023, Starlink collaborated with Africa Mobile Networks (AMN), a company that constructs mobile base stations in isolated communities, to include backhaul connectivity to more than 1,500 base stations in remote Nigerian regions with no fibre connectivity so that local operators can provide 3G and 4G services to the communities that would otherwise be non-existent (Tech in Africa, 2 In May 2025, it planned to form a similar partnership with Airtel Africa with the goal of connecting schools and hospitals in 14 countries in Africa. In NCC licensing talks, Starlink

promised to invest 107 million in Nigeria, of which 27 million was to be used to offer free high-speed internet to 5,000 rural schools, which could reach 2.4 million children (Tech in Africa, 2026). Such wholesale and institutional deployment mechanisms instead of the direct residential subscriptions could be the most scalable route to utilizing LEO satellite technology to mend the digital divide in developing countries.

Table 4: Digital Divide Bridging Strategy Framework — A Multi-Level Approach

Strategy Level	Intervention Type	Key Actors	Bridging Mechanism
1. Infrastructure	Fibre; mobile towers; LEO satellites; IXPs; data centres	Govt; Telcos; World Bank; African Dev. Bank; SpaceX/Amazon	Expands physical access; addresses 1st-level divide
2. Affordability	Subsidies; competition regulation; zero-rating; device tax waivers	NCC; Ministry of Communications; A4AI; ISPs	Reduces cost barrier; extends access to low-income users
3. Digital Literacy	School programmes; adult training; LIS curricula; community hubs	MoE; NUC; NLA; UNITAR; NGOs; Libraries	Addresses 2nd-level divide; converts access to meaningful use
4. Local Content	Indigenous language websites; local digital content creation; OA repositories	Libraries; universities; media; governments; NCC	Increases relevance of internet; promotes cultural sovereignty
5. Policy & Governance	National broadband plans; data protection laws; USF; WSIS follow-up	ITU; UN; national governments; AU; ECOWAS	Creates enabling environment; addresses systemic barriers
6. International Partnerships	ODA for digital; WEF EDISON Alliance; EU Global Gateway; G20 digital initiatives	Bilateral donors; MDBs; G7/G20; private sector	Mobilises finance and technical assistance at scale

Table 4: Author's Strategic Framework (2024); adapted from Development Aid (2024); Bon et al. (2024); Grokipedia (2026); ITU (2024)

International Development Partnerships and Multilateral Initiatives

In addition to bilateral and national policies, a multilateral coalition of efforts is closing the digital divide on an international level. The EDISON Alliance of the World Economic Forum is focused on ensuring 1 billion individuals have access to affordable digital connectivity through increasing connectivity and basic services in health, finance, and education. The Digital Development Strategy 20242030 of the United Kingdom specifically aims at reducing the gap in connectivity between the country and at least 20 partner nations by half by the year 2030 (Development Aid, 2024). The EU Global Gateway infrastructure project, mobilising up to €150 billion to partner countries, entails a digital element of broadband infrastructure, digital skills, and e-government in Africa, Latin America and Asian partner countries. The G20 Digital Economy Task Force has set digital infrastructure and digital literacy and cross-border data flows action plans, which, once implemented, can greatly accelerate connectivity in G20 member developing countries such as Nigeria, South Africa, and India.

In the case of libraries, the Strategy 20192024 (and subsequent 20262031) of the IFLA has made access to information and digital equity core advocacy areas of the library sector, urging library communities around the world to be champions of the cause of universal, meaningful access to the internet as a prerequisite to free flow of information. The IFLA Congress on Library and Information Science Education (IFLA-LISE) has grown to highlight that LIS professionals as the professional custodians of the equity in information access have a special responsibility in bridging the digital divide gaps within their communities and countries (IFLA, 2022).

CHALLENGES TO BRIDGING THE DIGITAL DIVIDE

The Moving Target of Technological Innovation

The most pernicious obstacle to digital divide bridging, perhaps, is the so-called moving target phenomenon: due to the ever-present technological innovation in the developed world, new kinds of digital advantage are created constantly, which developing countries can structurally not keep abreast. Developed countries were moving to 5G as 4G networks were being rolled out at large scale in developing countries in the 2010s. As developing countries roll out 5G, developed

countries already roll out 6G research infrastructure and AI-enabled network management. This is best exemplified by the ITU data of 2024: 5G covers 84 percent of the population of high-income countries but only 4 percent of the population of low-income countries - an 80-percentage-point difference at the high-tech frontier to connection (ITU, 2024). This displacement in technological frontier implies that the bridging strategies that are aimed at following up to the existing standards are structurally predetermined to be in a perpetual losing position.

This difficulty is especially pressing on the AI dimension. The records of ISPI (2025) indicate that the number of AI-related incidents has increased by 1278 percent in 2022 to 2023, as the technology is spreading into the society; but the ability to create, implement, possess, and enjoy AI is extremely concentrated in the hands of a few technologically advanced countries. UNCTAD cries foul, saying that the data economy is under the threat of being permanently controlled by a small group of stakeholders in a small number of technologically advanced economies (UN Press, 2023). According to Bon et al. (2024) of the Digital Humanism series of Springer, even so-called free internet projects of large tech companies cast doubt on the concept of digital sovereignty: linking the users of the developing world to platforms that harvest their data without offering much control over the latter introduces a new layer of informational colonialism that can only serve to increase instead of decrease the digital divide at its most structural level.

Infrastructure Investment Deficit and Financing Gaps

The type of infrastructure investment which is necessary to bring significant internet connectivity to developing countries is incredible. Alone, Nigeria has a 100-billion-a-year deficit in infrastructure investment (World Bank, 2019) in a country where digital infrastructure will have to compete with roads, electricity, water, healthcare, and housing to receive insufficient state funding. It was estimated by the World Bank that it would cost 1.4 trillion in capital spending to fully connect all schools and homes in developing countries to the internet, and that more than three-quarters (>1 trillion) of that expenditure would be required in low- and lower-middle-income countries (UNESCO, 2023; ISPI, 2025).

This infrastructure shortage in Nigeria is well exemplified by the endemic issue of fibre optic cable vandalism and theft, averaging 30-43 cuts per day across the country, which Nairametrics (2024), recognises as a key problem with broadband penetration. The operators have urged the Federal Government to criminalise the destruction of telecommunications facilities and give harsh penalties to the perpetrators. The 2024 report by the NCC also records the fact that total operating costs of telecommunications operators have risen by 81.97% in 2024 (to ₦4.58 trillion) and CAPEX has risen by 175.37% (to ₦2.71 trillion) - increases which reflect both the inflationary pressures on infrastructure investment and the increasing investment.

Governance, Regulatory Capture, and Political Instability

To bridge the digital divide, the conditions of governance, including regulatory independence, policy consistency, rule of law, and enforcement of anti-corruption, which are unevenly distributed in developing countries, are needed. Telecommunications In Nigeria, the telecommunications industry has enjoyed relatively successful NCC regulation, yet issues such as high Right-of-Way (RoW) charges imposed by state governments and local authorities (which raise the cost of fibre deployment) and various taxation by different levels of government, and bureaucratic delays in licence applications have restricted entry into the market and fibre infrastructure growth (Nairametrics, 2024; The case of Starlink in Nigeria demonstrates the regulatory aspect in a more concrete way: the two-year-long negotiations with the NCC before its commercial launch in February 2023 took place represent a delay that delayed the connectivity benefits to Nigerian customers.

In a wider sense, the experience of telecommunications regulation in developing countries has shown that the design of regulatory interventions (market structure (monopoly vs. competition), universal service fund design), spectrum allocation, and interconnection pricing) has far reaching impacts on the results of connectivity. Countries that have autonomous, effective, telecommunications regulators, transparent spectrum auctions, and well-funded universal service funds always fare better than those with captured, politicised, or under-resourced regulatory frameworks in terms of connectivity growth (Connecting the Unconnected, 2023; Bon et al., 2024).

Gender, Language, and Cultural Digital Divide Dimensions

The gender aspect of the digital divide should be given special attention as a human rights issue and an obstacle to connectivity that has economic and social implications. The count of men who use the internet worldwide is 70 percent of the 65 percent of women- leaving 189 million more men than women on the internet in 2024 (ITU, 2024). This gender disparity is higher in Africa as the Gender Parity Score is 0.72 (as opposed to 0.981.02 worldwide to denote parity), and it implies that African women are highly unlikely to have an online presence compared to African men (ITU Africa, 2025). The GSMA Mobile Gender Gap Report (2022) concluded that women in low- and middle-income countries are 16% less

likely to use mobile internet than men, and 900 million women in LMICs will continue to be offline in 2023 (DataReportal, 2024).

These gender inequalities mirror various overlapping obstacles: cultural and social constructs limiting women to independent mobile device use; educational inequalities diminishing women and their digital literacy; economic reliance limiting women to control household technological expenditure; and safety issues of online harassment that cause psychological barriers to female use of the internet (GSC Advanced Research, 2025). The digital divide closing policies that disregard gender aspects will strategically replicate and perpetuate informational exclusion of women.

Language barriers are a similar and equally significant issue. With online content dominated by English (the second language, which covers about 52 percent of all websites), the non-English speakers experience a second-order barrier to access even when they are physically in their vicinity. The lack of representation of African languages (Yoruba, Hausa, Igbo, Swahili, Amharic, etc.) in the internet, AI training data, and digital tools makes the digital realm unfamiliar, inappropriate and alien to many potential users. The digital content of indigenous languages is a strategic focus in increasing the volume, quality, and accessibility of digital content in indigenous languages to make internet connectivity culturally meaningful to the diverse linguistic communities in Africa (Bon et al., 2024; Imran, 2023).

Table 4: Key Challenges to Bridging the Digital Divide and Strategic Responses

Challenge	Specific Manifestation	Strategic Response
Moving technology frontier	5G gap (84% vs 4%); AI divide; perpetual technological deficit	Technology leapfrogging strategies; LEO satellite deployment; South-South technology transfer
Infrastructure financing gap	Nigeria $100B annual gap; $1.4T to connect all schools globally	MDB financing; PPPs; EU Global Gateway; EDISON Alliance; domestic broadband levies
Affordability barriers	Nigeria mobile data >4% GNI per capita; fixed broadband >33% monthly income (LICs)	Competition regulation; USF subsidies; zero-rating; device tax waivers; ISP price caps
Digital literacy deficit	Only 27% of LDC adults have basic digital skills (ITU, 2024)	National digital literacy curricula; community digital hubs (CITAD Nigeria); DLIP; library training
Governance failures	High RoW fees; cable vandalism (30–43 daily cuts in Nigeria); regulatory delays	Criminalise infra vandalism; unified RoW framework; streamlined spectrum allocation
Gender digital divide	189 million more men online; Africa GPS=0.72; 900M women offline (LMICs)	Gender-targeted digital literacy; affordable women's devices; culturally responsive outreach
Language/content barriers	52% of web content in English; under-representation of African languages online	Indigenous language content grants; multilingual AI development; open digital content repositories
Data sovereignty & AI divide	Risk of permanent data economy domination by few economies	African data governance frameworks; AU data policy; local AI training data initiatives

Table 4: Author's Synthesis (2024); sources as cited in text

PROSPECTS OF A BRIDGED DIGITAL DIVIDE: TOWARDS FREE INTERCONTINENTAL INFORMATION FLOW

Grounds for Cautious Optimism

Nevertheless, in spite of the above list of obstacles, there are significant empirical reasons to be optimistic (cautiously so) that there will come a time when the global digital divide is substantially bridged- especially in the African context. In Africa, the mobile internet access increased by +41.1 points in the period 2014-2023 - the most significant change in the Access to Mobile Internet sub-indicator of all the Ibrahim Index of African Governance in this decade (Mo Ibrahim Foundation, 2025). Sub-Saharan Africa experienced a six-fold increase in the absolute number of internet users between 2010 and 2023, with an increase in 2023 to more than 600 million, compared to about 100 million in 2010. In November 2025, Nigeria surpassed the 50 percent broadband penetration mark-a milestone that would have appeared far-fetched five years prior. Mobile internet penetration has reached new income levels formerly locked out, with the spread of low-end Android smartphones, and mobile data costs have dropped dramatically in Africa in the last ten years.

The advent of LEO satellite internet, with Starlink operational in 23 African countries by 2025 and Amazon Project

Kuiper about to enter service, promises to be a potentially ground-breaking additional connectivity option to the most remote and infrastructure-deprived populations. In Q1 2025, Starlink was 7.6 times faster than the traditional ISPs in Burundi and 6.6 times faster in Mozambique, proving that the technology was able to provide connectivity quality in previously underserved markets on a level similar to the developed world (Tech in Africa, 2026). The fact that the WEF EDISON Alliance aims to provide affordable digital access to 1 billion individuals and that the Digital Development Strategy 202430 of the UK aims to reduce connectivity gaps in 20 partner countries by half, are indicative of the fact that digital inclusion is now a development agenda and not an outlying technology concern (Development Aid, 2024).

The Information Flow Prospect: Libraries, Open Access, and Knowledge Equity

The issue of closing the digital divide has implications in particular to free intercontinental information flow to libraries and information professionals. The most notable structural process towards democratising access to knowledge globally without incurring the per-transaction costs of connection is the Open Access (OA) movement that aims to make scholarly research accessible to all readers across the internet. By making research available in OA journals, OA repositories, or freely available through OA mandates, internet access becomes adequate (no subscription fees are required) to access the best of the best research in the world--which could revolutionize the landscape of scholarly information to academics and students in the developing world.

The NUC Virtual Library of Nigeria, offering free access to about 95,000 e-journals via HINARI, AGORA, OARE, and EBSCO Host, is an example of what a well-coordinated information access infrastructure at the institution level can do even in a connectivity-limited environment. Any Nigerian university scholar who publishes in an open access journal, deposits their dissertation on a university repository, or participates in a digital knowledge commons makes a minor yet significant contribution to the free intercontinental information flow. Libraries, as IFLA (2022) contends, would be the most suited to act as exemplars, educators, and facilitators of the information equity that would be achieved through bridging a digital divide.

The future of the digital divide scenarios, as proposed by Development Aid (2024), differ radically. With limited investment and policy coordination, with connectivity, also expensive and uneven and with AI capacity concentrated in a few countries, the digital divide turns into a structural opportunity gap that further enhances inequalities between and within nations. In collaborative context, where structured investment, policies integration, development of digital literacy, and technology transfer converge to fast-track the meaningful connectivity in developing countries, the digital divide becomes small enough so that truly free intercontinental information flow becomes a reality within a generation. The decision between these scenarios is not technological, it is political, economic, and ethical.

Table 5: Prospects for Digital Divide Bridging — Key Indicators and Targets (Africa/Nigeria)

Indicator	Current Status (2024–2025)	Target / Projection	Source
Nigeria broadband penetration	50.58% (Nov 2025)	70% by end-2025 (missed)	TechCabal (2025)
Africa mobile internet penetration	27% (SS Africa, 2023)	80% broadband (AU by 2030)	GSMA (2023); AU Strategy
Starlink coverage in Africa	23 countries operational (2025)	Continent-wide expected by 2026	Telegeography (2025)
Global offline population	2.6 billion (32%, 2024)	Universal connectivity (Connect 2030)	ITU (2024); DISD-UN (2024)
WEF EDISON Alliance access target	Programme operational (2021–)	1 billion additional users by 2030	DevelopmentAid (2024)
Africa mobile GDP contribution	$140B in SS Africa (2023)	+$30B with better connectivity	GSMA (2023)

Table 5: Compiled from Tech Cabal (2025); GSMA (2023); AU Digital Transformation Strategy (2020); ITU (2024); Telegeography (2025)

CONCLUSION

The digital divide between developed and developing countries cannot be addressed as a mere technical issue that a technological solution can help solve; it is a multi-tiered, multi-actor, multi-dimensional socio-economic, political, and cultural issue that has to be addressed in a multi-level manner. Recent statistics affirm both the progress that has been

achieved-5.5 billion people online in 2024, mobile internet access in Africa increasing at an unprecedented pace, Nigeria having more than 50 percent broadband penetration, and the scale of the remaining challenge-2.6 billion people offline, a gender digital divide impacting hundreds of millions of women, a 5G technology gap of 80 percentage points, and the emerging AI

In the case of Nigeria, the biggest digital market in Africa, the most populous country in the continent with the biggest number of people using the internet, and a country where its universities, libraries, and information institutions are keenly concerned about the future of free information flow between continents, the digital divide issue is acute and solvable. The NUC Virtual Library, the Starlink partnership model, infrastructure investments in the National Broadband Plan, and the dynamism of the fintech and digital economy sectors have shown that the country can make significant progress. The only thing that is needed is a sustained, well-funded, gender-sensitive, and governance-enhanced application of the entire system of strategy described in this paper infrastructure investment, affordability reform, digital literacy development, local content creation, satellite technology roll-out, and international development partnership.

The final vision, free intercontinental information flow in a world where all people, irrespective of nationality, income, gender, language or location, can access and contribute to the body of knowledge of mankind, is the vision of the information professional of a world where no one is left behind, as the UN has seen it. Libraries, with their unmatched role as the universal agents of knowledge access, have a unique part to play in this desire: they can promote the policies of digital equity, offer the digital literacy programmes, roll out the information access systems, model the inclusive, equitable information practices that a bridged digital divide would enable all to pursue.

RECOMMENDATIONS

- The Federal Government of Nigeria ought to announce the broadband internet access as a national public utility and create a law that would safeguard telecommunications infrastructure against vandalism and create criminal penalties that would be equivalent to the national economic price of disruption to the networks.
- The NCC ought to reformulate the National Broadband Plan of 20252030 with achievable yet ambitious goals, backed by a national broadband investment fund that is funded by a 1 per cent digital economy levy on the revenues of large digital platform businesses in Nigeria.
- As a benefit of Open Access publishing, the libraries of Nigerian universities must be leaders in implementing Open Access publication policies, whereby all institutional research findings must be placed into open-access repository within six months of publication--contributing directly to the free intercontinental information flow by making Nigerian scholarship discoverable and accessible globally without connectivity costs.
- The African Data Sovereignty Framework: The African Union ought to create an African Data Sovereignty Framework-a continental regulatory framework that guarantees that African states own, and enjoy, the fruits of data generated by African citizens and institutions, without extracting Africa's data wealth without giving it a developmental pay-off.
- Key recommendations: International development organisations such as the World Bank, African Development Bank, bilateral donors must focus on digital literacy and meaningful connectivity programmes as well as physical infrastructure investment because the statistics of broadband penetration conceal major deficits in second and third-level divide among so-called connected populations.
- Digital equity advocacy, digital divide theory, and information access policy need to be taught in LIS schools in Nigeria and on the continent of Africa as the next generation of information professionals is prepared to be a hands-on promoter of the free intercontinental flow of information that the values of the library profession require.
- Governments in Africa ought to craft regulatory frameworks of LEO satellite internet that strike a balance between consumer protection, local investment needs, and national security concerns against the need to expand connectivity fast without regulatory measures that sideline transformative technologies in the market at the expense of upholding legitimate public interests.
- UN ITU and UNESCO should work together to create a Global Digital Language Equity Programme, where they fund the creation and maintenance of high-quality internet content in African languages and incorporate data on African language training into the global AI development projects to ensure that linguistic digital inequalities are not carried into the AI age.

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