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BROADBAND AS KEY DIGITAL INFRASTRUCTURE

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ABSTRACT

The digital divide is taking on new forms, even as access gaps narrow. Digital technologies are expanding in scale, reach, and impact. Policymaking and regulation have shifted from focusing on basic access to telecommunications and the internet to recognizing different types of digital inequalities and their implications for access to education, healthcare, e-government services, employment opportunities, and participation in the digital economy. This paper presents the first part of a review of global broadband technology development, based on the findings of the ITU report "Status of Broadband Targets." The article will explore solutions to making broadband policy universal and broadband more accessible. It will also address issues of global internet coverage.

KEYWORDS: *ITU; telecommunications; broadband technology development;* internet; digital inequalities; digital technologies

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Introduction

Digital technologies are expanding in scale, reach, and impact. Policymaking and regulation have shifted from focusing on basic access to telecommunications and the internet to recognizing different types of digital inequalities and their implications for access to education, healthcare, e-government services, employment opportunities, and participation in the digital economy.

The ITU report [1] notes that policymaking has evolved to include new and emerging topics such as digital transformation and artificial intelligence. Significant progress has been made in ensuring accessibility, with the mobile broadband access target achieved globally, while the fixed broadband access target has not yet been met. More than two-thirds of the population regularly uses the internet, and digital skills generally continue to develop as more people become online.

Digital financial inclusion is growing among some online populations, particularly youth, globally. Among firms and enterprises, connectivity and digital capabilities vary significantly by size, although significant data limitations make it difficult to assess enterprise connectivity in some regions of the world. Available survey data suggest that internet access and digital capabilities among micro, small, and medium-sized enterprises (SMEs) are generally improving over time. The gender digital divide is narrowing in absolute terms in the number of internet users.

The ITU/UNESCO Broadband Commission for Sustainable Development was established in 2010 following the 2007/2008 financial crisis. Governments were convinced that broadband could play a vital role in economic recovery and in promoting citizen-centered services to achieve development goals and economic progress.

After fifteen years of focused policy and statistical analysis, the ITU/UNESCO Broadband Commission for Sustainable Development continues to believe that broadband stakeholders are well-positioned to realize the potential and opportunities of broadband for improved development outcomes. Telecommunications services, infrastructure providers, and operators have enabled and contributed to fifteen years of relatively stable economic growth across various countries and economies. Many of the world's largest companies (by revenue and market capitalization) are now digital, technology, or semiconductor companies. Broadband infrastructure has proven versatile, providing broadband internet access as well as new services and applications, such as distributed computing and artificial intelligence (AI), that rely on broadband infrastructure.

Overview of developments in mobile communications and broadband access

The digital economy is continuing to expand, entering into all aspects of our lives. Growth in the number of Internet users needed to achieve digital inclusion continues, with the online population adding an additional 280 million people over 2023 to reach 5.5 billion people regularly online by end-2024, equivalent to just over two-thirds or 68% of the total global population (Figure 1).

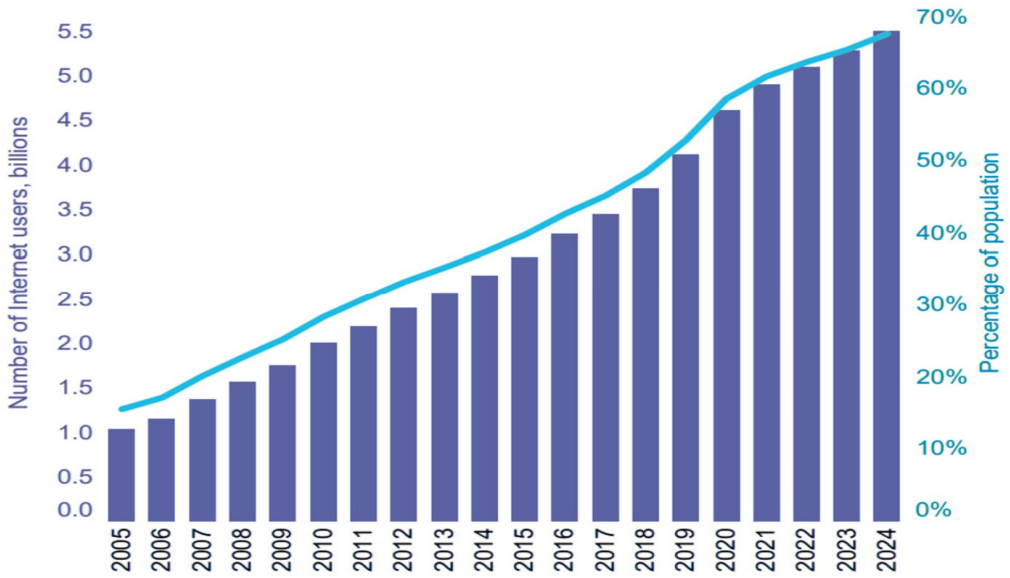

Figure 1. Individuals using the Internet, 2005-2024 [1]

However, this still leaves some 2.6 billion people offline, around 32% or one- third of the global population [2]. This gap in the number of Internet users can be distinguished from the "usage gap" of people living within mobile broadband coverage but not using it (estimated at 38% of the global population in 2022), as well as the coverage gap (estimated at around 5% of people, living in areas still not covered by mobile broadband [3]). Today, offline populations and communities risk being excluded from opportunities created by the digital economy, as well as many citizen services (e.g. in e-government, health and education). Indeed, the expansion of mobile broadband across different verticals such as manufacturing, finance, construction and communications is a bedrock for fresh growth in the digital economy.

Mobile communications is also continuing to grow steadily. The GSMA estimates that globally, there were 8.87 billion mobile connections by the end of 2024, projected to reach 9.99 billion mobile connections in 2030 (Figure 2).

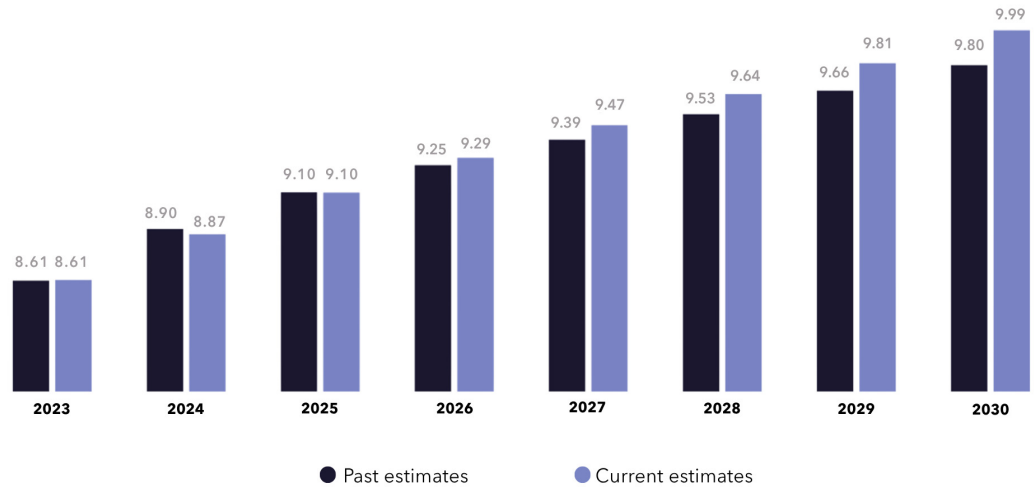

Figure 2. Growth in Global Mobile Connections, 2023-2030 [1]

The number of 5G base stations in China amounted to 3.92 million by June 2024, equivalent to a third or 33% of the total number of mobile base stations in China [4]. The number of 5G mobile subscribers exceeded 927 million in June 2024 (52.4% of total mobile subscribers in China). The Ericsson Mobility Report estimated that 5G subscriptions in India reach around 970 million by the end of 2030, accounting for 74% of mobile subscriptions [5].

Meanwhile, growth in connected devices and demands on networks (including from fixed wireless access solutions) is fuelling massive traffic growth. Total mobile data traffic is estimated to treble between 2023 and 2029. At the same time, the nature of the expectations and demands placed on networks, by users, applications, and use cases is changing. In 5G's programmable networks, developers using network APIs, are dynamically calling or leverage individual network capabilities, such as high peak data rates, or ultra-low latencies, into a new generation of applications and use cases. This both unlocks fresh innovation across private and public sectors, whilst also adding a further dimension to the digital divide.

According to ITU's most recent data (Figure 3), four out of five individuals aged 10 years-old or over own a mobile phone. In terms of where these subscribers are located, phone ownership exceeds 90% of the population in high-income countries (96%), Europe (95%) and CIS (94%). The lowest phone ownership rates are in low-income countries (56%), LDCs (63%) and LLDCs (65%).

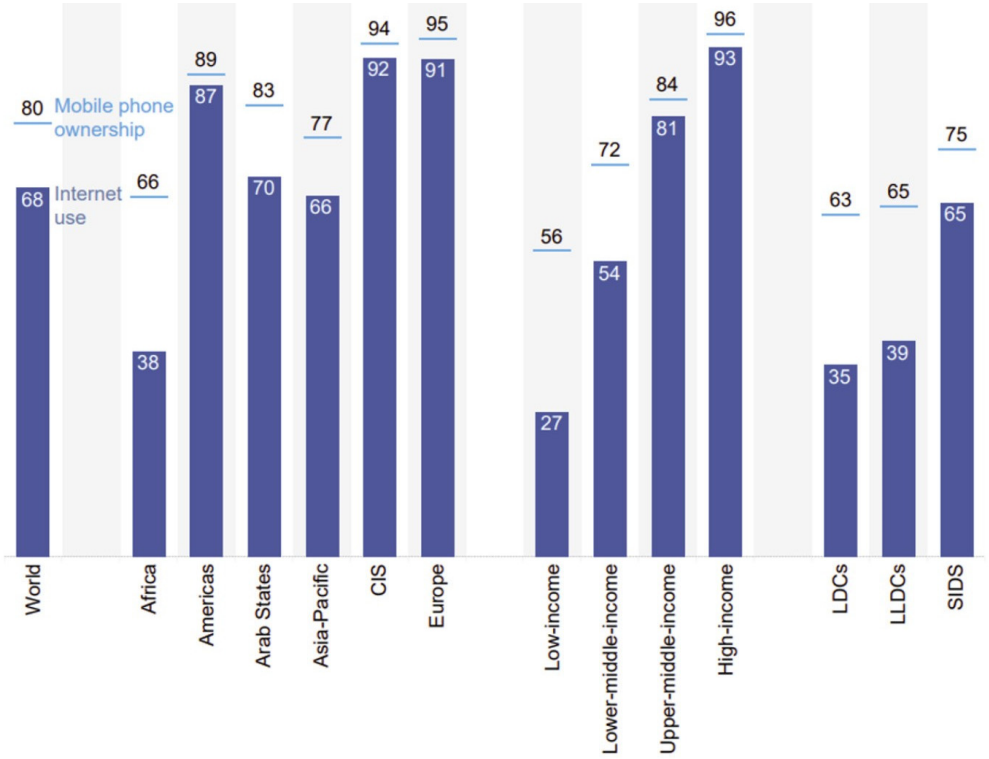

Figure 3. Percentage of individuals owning a mobile phone and using the Internet, 2024 [1]

In the meantime, digital technologies are evolving and diversifying, and encompassing developments such as Artificial Intelligence (AI). AI is no single technology, but instead comprises multiple different services, types of models, and the connection of "many different data sources", often distributed across hybrid IT infrastructure [6]. AI is increasingly managing network complexity and orchestrating network demands, which is essential in the new era of programmable networks. In turn, AI-infused networks are better able to meet the diverse demands of AI use cases that enterprises, governments and consumers place on networks.

We stand on the brink of a future that will be significantly shaped by AI, which holds immense potential to accelerate progress across the SDGs. However, such benefits risk being distributed unevenly – most notably, in the Global South – if our global community does not immediately and concertedly shape its trajectory at this critical stage, focusing on four key components.

First, from advancing access to healthcare and education to driving climate action, AI is already transforming lives. However, to ensure that these benefits reach everyone, it is crucial to strengthen countries' Digital Public Infrastructure (DPI), which will lay the groundwork for AI's positive impact to flow widely and equitably.

Second, AI must be developed and deployed inclusively. AI systems are often trained on datasets sourced mainly from the Global North, creating information asymmetry and an imbalance in data representation. This often results in AI models with low local relevance and benefit. AI must be specifically designed to reflect the needs, challenges, and opportunities of developing countries.

Third, tailored support at the country-level is needed to ensure that AI is harnessed to its maximum potential for inclusive development.

Accelerating digitalization with AI is crucial to improving of meeting the Sustainable Development Goals (SDGs). Modern connectivity plays a foundational role in digitalization: AI makes that role greater. For instance, 5G acts as a platform for connected technologies and solutions to flourish, enabling societal benefits that contribute to the SDGs. Today's AI enhancements, including in network performance and operational efficiency, give more potency to the 5G platform.

Looking ahead, new technologies are being architected to enable networks to self-heal, self-organize, and self-configure, helping them manage the increasingly complex demands of digitalization. The pace of AI-infused innovation within and on top of the network is rapid and necessary to close the gap toward the SDGs. Rapid advancement requires regulation which enables innovation.

A broad approach to regulating AI technology should be avoided, otherwise it risks stifling needed investment and innovation. As always, continuous dialogue between industry, policy-makers, and other stakeholders is essential. Building trust around AI usage and development is key. No less important is the need to safeguard interoperability to help provide affordable, scalable, and modern connectivity.

Emerging technologies present significant opportunities for the telecom sector. AI can dramatically improve network management through predictive analytics, enabling more efficient traffic handling and fault management. However, the integration of these technologies also introduces complex challenges and risks. The financial implications of adopting high-end AI solutions pose considerable challenges, particularly for operators in developing regions where investment in such technologies may not be feasible without supportive regulatory frameworks and financial models. Cybersecurity remains a paramount concern, as more intelligent networks are potentially more vulnerable to sophisticated cyber-attacks. Ensuring the security of these systems is critical, especially as they become integral to delivering essential services, including healthcare.

The deployment of AI could inadvertently exacerbate the digital divide, with less developed regions struggling to keep pace with the rapid technological advancements seen in more developed markets. This necessitates a balanced approach in regulatory frameworks that not only encourages innovation but also ensures equitable access to technology.

Adopting human-centric and responsible AI and GenAI-based tools is vital to boost the global digital economy. AI-driven predictive maintenance can enhance broadband infrastructure, improve broadband customers experience by ensuring more reliable and widespread access while AI-powered virtual assistants and chatbots can provide 24/7 support, helping users navigate digital services and access vital information.

The risks associated with GenAI, such as increased inequality, non-availability of complete, and quality data, copyright infringements, and embedded biases, highlights the need for careful monitoring and iterative improvements. Ensuring GenAI systems are trained on diverse and representative quality datasets is crucial to mitigating these risks.

In fact, the Digital Cooperation Organization (DCO) Member States have demonstrated their commitment to responsible AI adoption by signing the Riyadh AI Call for Action Declaration (RAICA), reaffirming their shared desire to harness AI's potential to improve lives worldwide. The DCO is developing several AI initiatives, including an AI toolkit to assist Member States in assessing AI readiness and integrating AI, including GenAI, into business systems to enhance productivity, service quality, and efficiency. This includes creating controlled testing environments with flexible AI regulatory frameworks, enhancing global cooperation on AI governance, and encouraging investments in AI digital skills and requisite infrastructure.

By promoting cooperation through joint research and shared service platforms, stakeholders can balance AI innovation with regulatory measures. While GenAI offers many opportunities to enhance connectivity and sustainable development, the DCO recognizes the importance of addressing associated challenges and risks through collaboration and comprehensive co-created digital strategies. By leveraging GenAI responsibly, we can make significant strides toward achieving the Broadband Commission's Advocacy Targets and building a more inclusive, sustainable and connected global digital economy.

Broadband as key Digital Infrastructure

By 2025, all countries was planned to have a funded National Broadband Plan (NBP) or strategy in place or include broadband in their Universal Access and Service (UAS) Definition. A sound policy approach should also promote action to enhance broadband access and/or when broadband is included in countries' Universal Access/Service (UAS) definitions.

Research suggests that this target is not achieved. Despite increases in broadband coverage globally, a number of National Plans have expired and not been renewed (ITU, 2023). In 2024, 167 countries had a national broadband plan or other strategic document emphasizing broadband, marginally down from 170 in 2022. Figure 4 depicts the national strategy planning process.

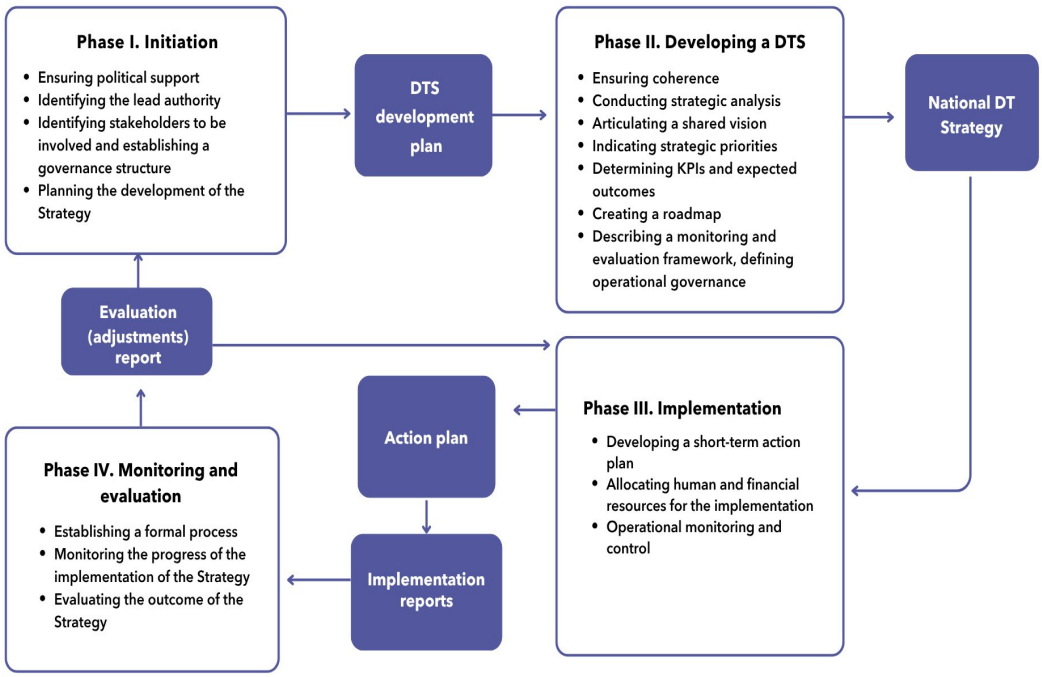

Figure 4. The national strategy planning process [1]

Today, digital transformation is the new focus of policy-making, as countries seek to address the far-reaching ramifications of digital policy. National digital infrastructure is recognized as just one building block of strategies for digital transformation. The era of discrete Plans for the telecom or broadband sector are broadly over. Today, Digital Agendas, National Visions or National Strategies on AI are increasingly the focus of policy-makers' attention.

Broadband infrastructure planning is expensive, complex and needs constant revision (Figure 4). Governments need to work in conjunction with the private sector, where much of the investment capital and expertise in relation to broadband and digital services now resides.

Further, it is now necessary to integrate and include the impact of AI on health sectors (e-Health strategies), transport and housing (Smart City Plans), Education (e-learning and edtech, school strategies) and security (cybersecurity and national defence). Important regional and sectoral strategies are being developed – for example, Europe's General Data Protection Regulation (GDPR) or the African Union's AI Strategy Roadmap or in Europe's Digital Health Action Plan [7], coordinated by the World Health Organization (WHO). For example, Figure 5 shows all the areas that Australia is taking into account in planning its digital economy strategy, which builds on and incorporates its Data Strategy, Cybersecurity Strategy, Blueprint for Critical Technologies, Digital Government Strategy and National Blockchain Roadmap.

Figure 5. Putting Australia's Digital Economy Strategy into Context [1]

Recent examples of Digital Strategies include Belize's National Digital Agenda for 2022-2025, Qatar's Digital Agenda 2030 adopted in March 2024, Guyana's efforts to advance its national digital agenda and Uganda's National Digital Agenda Strategy, launched in August 2024.

In 2025, entry-level broadband services should be made more affordable in low- and middle-income countries (LMICs). Making broadband more affordable is key to achieving universal and meaningful connectivity. This target specifies that prices for entry-level broadband services should be below 2% of monthly GNI per capita in developing countries by 2025. It is important that the total cost of ownership and use of broadband devices and connectivity is considered.

According to ITU's 2024 Facts and Figures report [8], fixed and mobile-broadband services continued to become more affordable in 2024, costing less as a proportion of income per capita in 2024, than in 2023. The data-only mobile-broadband basket and the fixed- broadband basket became more affordable in all regions and for all income groups.

Globally, the world has achieved the affordability target for mobile data-only broadband. For mobile data-only broadband, Latin America achieved the 2% target in 2024, meaning that all world regions have now achieved this target, except the African region. However, the fixed data-only broadband target has not yet been achieved, where Europe is the only region to have achieved the affordability target, although Asia-Pacific and the CIS region are approaching the target.

Similarly, in terms of income levels, a wide gap persists between high-income economies and the rest of the world. High-income countries are the only group of countries to have achieved the affordability target in both mobile and fixed broadband. Upper middle-income countries have achieved the affordability target in terms of mobile-broadband, but not fixed broadband.

In 2024, 114 economies out of 188 met the affordability target for at least the data-only mobile broadband or the fixed broadband basket, nine economies more than in 2023. However, among the low-income and middle-income economies, only 65 or around one-half of countries have met the Broadband Commission's affordability target for at least one of the two baskets. Given recent trends in ICT prices and income levels, it looks increasingly inevitable that most of the remaining 66 economies in that income group will miss the 2025 objective, even for entry-level broadband access.

In 2020, nearly 2.5 billion people lived in countries where the cost of the cheapest available smartphone was a quarter or more of the average monthly income, according to a 2020 survey of 70 countries by the Alliance for Affordable Internet (A4AI), equivalent to the share of monthly income that a typical European household spends on housing & utilities.

In some countries, devices were even less affordable still. In Sierra Leone, the average person needs to save six months' salary to buy the cheapest available smartphone. In India, where almost 18% of the global population now lives, the price of the cheapest smartphone from leading operator Jio was 206% of average monthly income. This is striking in a country that has some of the lowest-priced Internet data in the world.

There is a stark divide between countries for handset affordability. Botswana topped the survey for most-affordable devices, with a low-cost smartphone priced at just 4% of average monthly income, with Jamaica (5%), Mexico (5.7%) and Costa Rica (6%) following closely behind. While these countries are outliers at either end of the price spectrum, there is also wide disparity among regions. In Africa, devices were least affordable at 62.8% of average monthly income compared with 11.7% in the Americas and 16.2% in Asia-Pacific (excluding India). With India included, the Asia-Pacific figure jumps to 87.4% owing to India's role as an outlier with a very large population and relatively high costs.

A4AI makes the following recommendations:

1) duce taxes on low-cost handsets.

2) Support the use of Universal Service & Access Funds (USAFs) to subsidize devices.

3) Support fina ing plans to help low-income consumers spread the cost of devices over time.

Broadband-Internet user penetration should reach: 75% worldwide; 65% in low- and middle-income countries; and 35% in least developed countries, in 2025. Internet access is a priority because access to broadband Internet is fundamental to inclusive and sustainable development. Today, the Internet and broadband are increasingly vital for work, education, business, entertainment and global connection [12, 13].

In 2024, there was around 5.5 billion people online (approximately 2.8 billion male and 2.7 billion female Internet users), with another 2.6 billion offline. Internet use grew to an estimated 68% of the total global population in 2024 (Figure 6), up from 53% in 2019. There is still much to be done to achieve universal and meaningful connectivity. In 2024, Internet use was 93% in high-income countries, 54% in LMICs but just 35% in the LDCs (according to the most recent ITU estimates [9]).

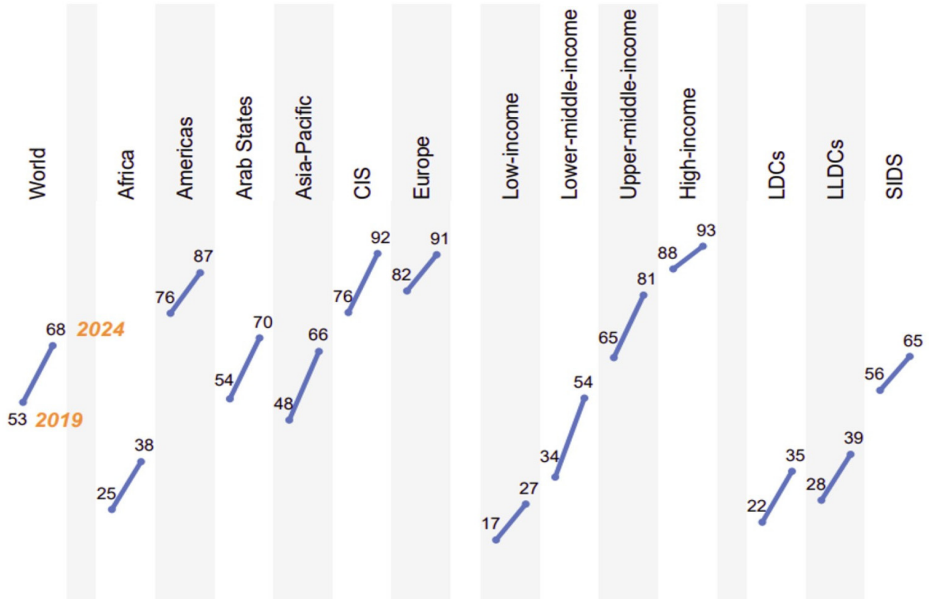

Figure 6. Percentage of individuals using the Internet by region, 2019 and 2024 [1]

However, there are also the first indications of 'digital disconnection'. For example, one survey suggests that the penetration of Internet users online in the UK actually fell for the first time [10]. The causes of this 'digital disconnection' are as yet poorly understood, but they may include factors as diverse as increases in the cost-of-living, disenchantment with the digital world (e.g. some parents are now giving children feature phones, rather than smartphones to try and limit screentime) and ageing populations in a growing number of countries. Separately, there are attempts by either parents or regulators and schools to deal with digital addiction or digital harms – for example, the recent ban on social media enacted for under 16 year-olds in Australia, or attempts by schools to limit, reduce or ban mobile phones in Australia, France and Switzerland.

As an example, the experience of Vodacom, which is using AI to expand its services in African countries, is interesting. Vodacom Group is a leading pan-African telco that provides an array of services from traditional products to financial services to over 200 million people in Africa. In addition to deploying various cloud-based digital platforms, products and tools across its footprint, Vodacom has deployed various AI tools (including machine learning and big data) to provide better services to customers in line with their needs, including mobile financial services products and loans.

One example of customers benefitting from AI is through an offer deployed in South Africa in 2017 and in the Democratic Rep. of Congo, Lesotho, Mozambique and Tanzania as of 2019, called 'Just 4 You'. It provides affordable, tailor-made bundles, created using machine learning and big data to design bespoke deals for each customer. Today, this package delivers great value to over 40 million customers in Africa, and it has evolved to offer smart discounts on fintech services and third-party offerings, as well as regional offers on voice and data bundles and some third-party services. In particular, it has become popular among customers on low incomes, as a best value deal.

Vodacom has also deployed various health and IoT solutions across Africa, and implemented process improvements across numerous areas, including in its call centres. Vodacom implements these innovations ethically and responsibly, taking various factors into account including each country's specific consumer protection laws and human rights laws.

Looking beyond the international digital divide, various digital divides persist at the national level, including in high-income countries. While overall Internet use is increasing, some marginalized groups are being left behind, such as the elderly, women & girls, people living in rural areas and people with disabilities.

In terms of new markets where Internet users are being added, China added 7.4 million new Internet users over 2024. In China, communication with family is still the main reason why offline individuals wish to go online, followed by the availability of Internet devices and free training in how to use the Internet.

Elderly individuals aged 60+ accounted for 62% of the total offline non-user population in China in June 2024. Lack of knowledge about how to use the Internet is perceived as the biggest barrier (49% of non-netizens), followed by lack of literacy in Pinyin or other literacy limitations (27.6%). Digital accessibility for the elderly and disabled groups is a significant driver in helping bridge the digital divide. By the end of June 2024, 2,792 websites and apps closely related to the lives of the elderly and people with disabilities were updated for accessibility. People aged 60+ accounted for 20.8% of new Internet users in the first half of 2024.

Singapore is another country facing a significant digital divide among older adults. The example below illustrates how Singapore is promoting digital inclusion for older adults.

Singapore regularly monitors Internet access and digital skills. Due to its urbanization and technologically savvy population, Internet access is available at home to 99% of all households. Senior-only households of people aged 60 years+ have:

• A 7% percentage point gap in terms of households with Internet access (93%) due to a perceived lack of need, skills, knowledge and confidence of seniors to use the Internet (up from 55% in 2017).

• Only 64% of senior households own a computer, due to a perceived lack of need or interest to own or learn to use computers (compared to 90% of all households and 98% of households with children).

• 89% of seniors aged 60+ own a smartphone (compared with 100% for all resident households).

With more time spent online, it is vital to ensure that citizens have the necessary knowledge and skills to protect themselves from online risks (e.g., scams, misinformation, harmful online content). The Government is building on existing efforts to:

• Highlight the need for all residents to keep their digital devices up-to-date (e.g., downloading and installing software patches, or upgrades) to reduce exposure to online risks.

• Help Singaporeans stay safe and alert online by teaching important cybersecurity skills, such as enabling two-factor authentication (2FA) and security checks when transacting online.

• Improve Singaporeans' information literacy. As the Internet has become the primary source of information for many people, we will continue efforts to help Singaporeans be informed and discerning consumers of information via initiatives such as the National Library Board (NLB)'s Source, Understand, Research, Evaluate (S.U.R.E) programme [11].

• Provide people with a better understanding of online harms that they may be exposed while connected. There are encouraging improvements in seniors' digital skills in various areas (e.g., communicating online, searching for information, transacting online).

The Infocomm Media Development Authority (IMDA) regularly monitors statistics for Internet connectivity by age. In 2023, only 45% of seniors are generally willing to try out new technologies, compared with 65% of Singaporeans aged 15 to 59 (IMDA, 2023). IMDA's Seniors Go Digital programme was launched in 2020 to help seniors embrace the benefits of going digital and equip them with knowledge and digital skills. Notably, seniors are becoming more comfortable with digital transactions. For instance, the percentage of seniors using online payments has more than doubled from 38% in 2018 to 78% in 2022. Also, more seniors are using the Singpass app in 2022 (67%), compared to 2020 (41%).

Conclusions

Importance of broadband Internet for sustainable development remains clear, as our societies continue to grow and develop, and more and more key services either move online or embed digital services.

Targets can play a key role in informing, influencing and shaping policy priorities at the national, regional and global levels. Despite progress in some areas, the number of countries with national broadband plans has stabilized, but Plans continue to become more comprehensive and extend beyond broadband and connectivity issues into holistic Digital Agendas.

Target is close to being achieved for mobile broadband affordability, but not for fixed broadband.

There has been strong progress in access to the Internet, but Internet access is often concentrated in urban areas, and is far from universal. The age digital divide is now a divide prevalent in many high-income countries (e.g. the UK, Singapore) or among the unconnected, offline populations (e.g. China).

After fifteen years of dedicated policy and statistical analysis, the ITU/UNESCO Broadband Commission for Sustainable Development continues to believe that broadband stakeholders are well-positioned to deliver on the promise and opportunities of broadband for improving development outcomes.

In the next part of this paper, continuing this topic, will provide an overview, which examines promoting digital skills development, increasing the use of digital financial services, connecting small and medium-sized enterprises to the internet, and bridging the gender digital divide.

REFERENCES

[1] The State of Broadband Advocacy Targets 2025. https://www.itu.int/hub/publication/s-pol-broadband-30-2025. Date of access: 10.07.2025.

[2] ITU Facts & Figures 2024, available at: www.itu.int/hub/publication/D-IND-ICT_MDD-2024-4/

[3] https://www.gsma.com/r/wp-content/uploads/2023/10/The-State-of-Mobile-Internet-Connectivity-Report-2023.pdf

[4] https://english.www.gov.cn/archive/statistics/202407/23/content_WS669f8be0c6d0868f4e8e9625.html

[5] https://economictimes.indiatimes.com/industry/telecom/telecom-news/number-of-5g-subscribers-in-india-may-triple-to-970-mn-by-2030-report/articleshow/115691585.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

[6] Feature: Nvidia, HPE chiefs address A... – Mobile World Live.

[7] WHO Press Release, 13 September 2022, www.who.int/europe/news/item/13-09-2022-countries-in-the-european-region-adopt-first-ever-digital-health-action-plan.

[8] ITU's 2024 Facts and Figures report. https://www.itu.int/hub/publication/D-IND-ICT_MDD-2024-4/

[9] 2Measuring digital development – Facts and Figures 2024 – ITU.

[10] Lloyds Consumer Digital Index 2023 report, available at: 231122-lloyds-consumer-digital-index-2023-report.pdf.

[11] singapore-digital-society-report-2023.pdf; www.channelnewsasia.com/commentary/singapore-elderly-tech-digital-isolation-social-lonely-4694131

[12] A. Vyukusenge "Increasing the capacity of fiber-optical transmission systems due to decreasing distances between bearing," Synchroinfo journal. Vol. 6, No. 6. pp. 21-23. 2020. DOI: 10.36724/2664-066X-2020-6-6-21-23.

[13] G. Kundimana and A. Vyukusenge, "Implementation Possibilities of Elastic Optical Networks Technology in Burundi Backbone Network," 2021 International Conference on Engineering Management of Communication and Technology (EMCTECH), Vienna, Austria, 2021, pp. 1-6, doi: 10.1109/EMCTECH53459.2021.9619177.