

BROADBAND AND CLOUD DEVELOPMENT INDEX 2024 REPORT

IDENTIFYING GLOBAL LEADERS
AND BEST PRACTICE



**WORLD
BROADBAND**
ASSOCIATION

This report provides analysis of the World Broadband Association's (WBBA) Broadband and Cloud Development Index (BCDI). The BCDI quantifies and ranks the performance of the two segments in major countries to identify leaders and best practices. This is to help industry stakeholders, including policymakers, regulators, service providers, and suppliers, to support the development and growth of the broadband and cloud industries in their respective countries. WBBA members include the following companies.*

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*This is not a comprehensive list of members; please visit <https://worldbroadbandassociation.com/> for the full list.

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SUMMARY

Following the successful launch of the Broadband and Cloud Development Index (BCDI) in 2023, the World Broadband Association (WBBA) committed to expanding the geographic coverage of the index. This expansion aims to significantly increase its scope and relevance for regulators, service providers, and suppliers worldwide.

As a result, 62 countries are included in the 2024 edition of the BCDI, which is a dramatic increase from the 21 countries covered in the inaugural BCDI in 2023. This means that the countries in the BCDI now account for over 90% of global GDP, compared with nearly 75% in 2023, and over 75% of the world's population, compared with nearly 50% in BCDI 2023.

The BCDI quantifies and ranks the performance of the fixed broadband and cloud markets in major countries to identify leaders and best practices. This is to help industry stakeholders, including policymakers, regulators, service providers, and suppliers, to support the development and growth of these key sectors in their respective countries.

The direct economic impact of broadband and cloud is clear, with the two segments combined set to generate over \$1tn in revenue worldwide by 2025. However, their indirect impact may be even greater, given that they are the key foundations of the digital economy that enable a wide range of digital applications and services that drive innovation, growth, and development globally.

Another enhancement to BCDI 2024 is the addition of three new metrics to ensure the index accounts for more key aspects of the broadband and cloud industries. The new metrics and the reasons for their inclusion are as follows:

- **AI adoption:** AI has the potential to transform the broadband and cloud industries, so the WBBA felt it was important to add a metric on the adoption of this vital new technology.
- **Data center investment:** Because data centers are the foundations of cloud services, the WBBA felt it was important to include a metric on the level of investment in these core platforms.
- **Sustainable energy:** Sustainability is increasingly important to not only the broadband and cloud industries but also to economies and societies overall. This led the WBBA to develop a metric on sustainable energy to include in BCDI 2024.

The many updates to BCDI 2024—including the significant increase in country coverage, addition of new metrics, and methodology refinements as detailed later in the report—also mean that the detailed country scores in BCDI 2024 are not directly comparable to those in 2023.

KEY FINDINGS

- There is a strong positive correlation of 73% between BCDI scores and GDP per capita by country, underlining the importance of the broadband and cloud industries for economic and broader social development.
- The strong correlation between BCDI scores and GDP per capita by country also validates the methodology of the BCDI and its ability to help stakeholders assess global best practices to drive improvements in their broadband and cloud markets and broader economies.
- BCDI countries passed the milestone of having a combined total of more than 1 billion fiber broadband subscriptions in 1Q24, in a sign of the industry's commitment to increasing the quality of broadband services, while also improving coverage. Fiber became the dominant broadband technology in 2023 across the 62 countries in the BCDI, accounting for an average of 53% of broadband subscriptions across all the countries, up from 49% in 2022.
- The global broadband and cloud industries will hit another milestone next year when together they will generate over \$1tn in revenue, based on Omdia market forecasts. This is a conservative estimate because it is based on Omdia's forecasts that global broadband service revenue will hit \$370bn in 2025, while the global business-to-business (B2B) cloud services market will hit \$664bn. It is important to note that Omdia's estimate that the broadband

and cloud markets will be worth over \$1tn worldwide in 2025 does not include other major segments, such as consumer cloud services.

- The BCDI results include scoring and ranking of countries. The ranking is not meant to criticize countries based on their scores or rankings. Instead, it aims to identify best practices in countries throughout the index. Stakeholders can then use the information to improve the performance of broadband and cloud markets in their respective countries.
- As consumer and enterprise adoption of digital devices, applications, and services continues to accelerate, it has become clear that basic broadband access is vital, but it is only the first step. Countries that invest in advanced broadband and cloud infrastructure see benefits across their economies and society as consumers and enterprises adopt more advanced digital applications and services, which in turn drive greater demand for broadband and cloud infrastructure.
- New applications and services are continually emerging in areas, such as AI, cybersecurity, the metaverse, and beyond, driving demand for investment in next-generation broadband infrastructure and cloud computing.
- The BCDI aims to provide new insight and examples for broadband industry stakeholders, including legislators, policymakers, investors, vendors, service providers, and enterprises, to address and drive forward the goals of democratizing broadband and cloud access to enable broader economic and social benefits.
- It is difficult to directly compare the results of one country to another because of the wide variety of countries in the index, their different stages of development, and the many unique characteristics of their broadband and cloud markets. To address this, the BCDI organizes the countries into the following three clusters:
 - **Cluster 1:** Countries where both the broadband and cloud markets have above-average scores in the BCDI. There are 21 countries in Cluster 1 with an average GDP per capita of \$47,913, ranging from the US and China at the top of the cluster to Brazil and Slovakia at the bottom.
 - **Cluster 2:** Countries where either the broadband or cloud market has an above-average score in the BCDI, but the other market does not. Cluster 2, which has 26 countries with an average GDP per capita of \$24,360, ranges from South Korea and Sweden to Egypt and Nigeria.
 - **Cluster 3:** Countries where both the broadband and cloud markets have scores that are average or below average in the BCDI. This cluster, which includes 15 countries with an average GDP per capita of \$6,882, ranges from Argentina and Malaysia to Uganda and Tanzania.
- The US ranks first in the BCDI, driven by its leading performance in broadband and a strong showing in the cloud. The US is the clear global leader in broadband usage and application, with top scores in online video users and views. The country's performance in broadband access has improved and is likely to continue to improve, owing to the US government's massive recent investments in the segment.
- China ranks second in the BCDI and stands out as the only country to achieve a top ranking despite having a GDP per capita well below the index average. It has benefited from successful government and industry initiatives that have made it a leading broadband and cloud market.
- The UK is among several European countries in Cluster 2 with above-average scores in broadband and below-average scores in cloud. Given its GDP per capita ranks number 20 out of the countries in the index, its number 24 ranking in BCDI is understandable. However, it does suggest there are opportunities to improve performance and move up the rankings.
- Egypt is among the three African countries, along with South Africa and Nigeria, which are in Cluster 2. This is due to their above-average cloud scores. Egypt ranks number 54 in the BCDI, in line with its number 52 ranking in GDP per capita among BCDI countries, driven by its fixed broadband penetration of 40% and fiber-to-the-home (FTTH) penetration of less than 1%. However, Egypt performs well in the cloud segment, where it ranks number 16 overall in the BCDI.
- India, the world's largest country with a population of 1.44 billion, has great potential in the fixed broadband and cloud markets. However, the country also faces significant challenges in realizing that potential. The country ranks number 55 in the BCDI, which is the same as its ranking by GDP per capita of the countries in the index. However, it has the highest cloud score in the cluster, partly owing to the strength of the country's IT sector.

RECOMMENDATIONS

Through the creation of BCDI and analysis of its results, the WBBA has developed the following recommendations to support the evolution of the industry to maximize economic growth and social benefits.

- **Assess BCDI results to identify best practices and learnings to support the development of the broadband and cloud industries in your country to foster broader economic and social development:** One of the key results of the BCDI in 2024 is that there is a strong positive correlation between BCDI scores and GDP per capita by country. In fact, in statistical terms, there is a 73% positive correlation between the two (that is, a correlation coefficient of 0.73). While that relatively strong positive correlation provides validation for the methodology and results of the BCDI, the wide range of the relationships between BCDI scores and GDP per capita in individual countries can also be used to uncover best practices for supporting the development of broadband and cloud industries in countries at all stages of economic development.
- **Understand the importance of developing policies, market structures, and investments to support the development of fiber broadband services:** One of the findings of the BCDI is that government and industry support for investment in fiber broadband is one of the best ways for countries to develop both their broadband and cloud markets, irrespective of the country's level of economic development. Evidence for this comes from analysis of countries that have relatively low GDP per capita but nevertheless achieve above-average BCDI scores in both broadband and cloud. One thing that these countries—including China, Romania, Oman, Brazil, and Slovakia—have in common is relatively high fiber broadband coverage and adoption compared with other countries in the BCDI. This suggests that the development of advanced fiber broadband services also supports the growth of cloud services even in countries with relatively low GDP per capita. This strengthens the case for countries at all stages of economic development to support fiber services.
- **Gauge best practices, challenges, and learnings for developing the broadband and cloud industries in a variety of countries:** Case studies on the US and China from Cluster 1, the UK and Egypt from Cluster 2, and India from Cluster 3 illustrate the wide range of approaches that countries are taking to regulate and support their broadband and cloud industries and their varying levels of success.
- **Evaluate the impact on the broadband and cloud industries of key trends, such as AI adoption, cloud-network convergence, and sustainability:** Understanding the key trends, applications, and services driving the broadband and cloud industries puts the detailed results of the BCDI in context. It also explains why the WBBA has added new metrics to the BCDI on AI adoption, data center investment, and sustainable energy to ensure the BCDI accounts for these key trends.
- **Promote collaboration between the broadband and cloud industries:** There is a need for broadband and cloud providers to collaborate more at the industry level to support the harmonization of relevant standards, technologies, and supporting processes, such as product certification. This will support the development of new converged broadband and cloud infrastructure and business models, enabling the next phase of digital and economic growth.

KEY TRENDS IN FIXED BROADBAND AND CLOUD DEVELOPMENT

Research for the BCDI has uncovered several key trends in the broadband and cloud industries that help to drive the performance of countries in the index, including the increasing adoption and quality of broadband services; the socioeconomic benefits of broadband; ongoing technology innovation; telco business model transformation; the convergence of broadband and cloud networks; and the increasing importance of cybersecurity and sustainability.

INCREASING ADOPTION AND QUALITY OF SERVICES (QOS)

Although increasing broadband adoption has long been a priority for service providers and regulators, it is important to note that it continues to increase in most countries in the BCDI. In fact, across all 62 countries in the newly expanded index, fixed broadband household penetration increased by an average of 2% from 2022 to 2023, based on Omdia's World Broadband Information Series (WBIS) Data Dashboard. To put that into context, this means that across all the countries in the index, there were close to 70 million more households with broadband internet access in 2023 compared with 2022.

At the same time, as broadband penetration increases, stakeholders naturally focus on improving both the quantity and quality of connections. One way to assess this is the percentage of total fixed broadband connections based on fiber, the most advanced broadband technology. That achieved a key milestone last year when fiber became the dominant fixed broadband technology in most countries in BCDI. In other words, fiber's share of total fixed broadband subscriptions was 50% or greater in 33 of the 62 BCDI countries. In addition, another major milestone was reached in 1Q24 when total fiber broadband subscriptions across the 62 BCDI countries topped 1 billion for the first time, highlighting the drive to accelerate coverage and adoption of the most advanced broadband technology.

SOCIOECONOMIC BENEFITS OF BROADBAND

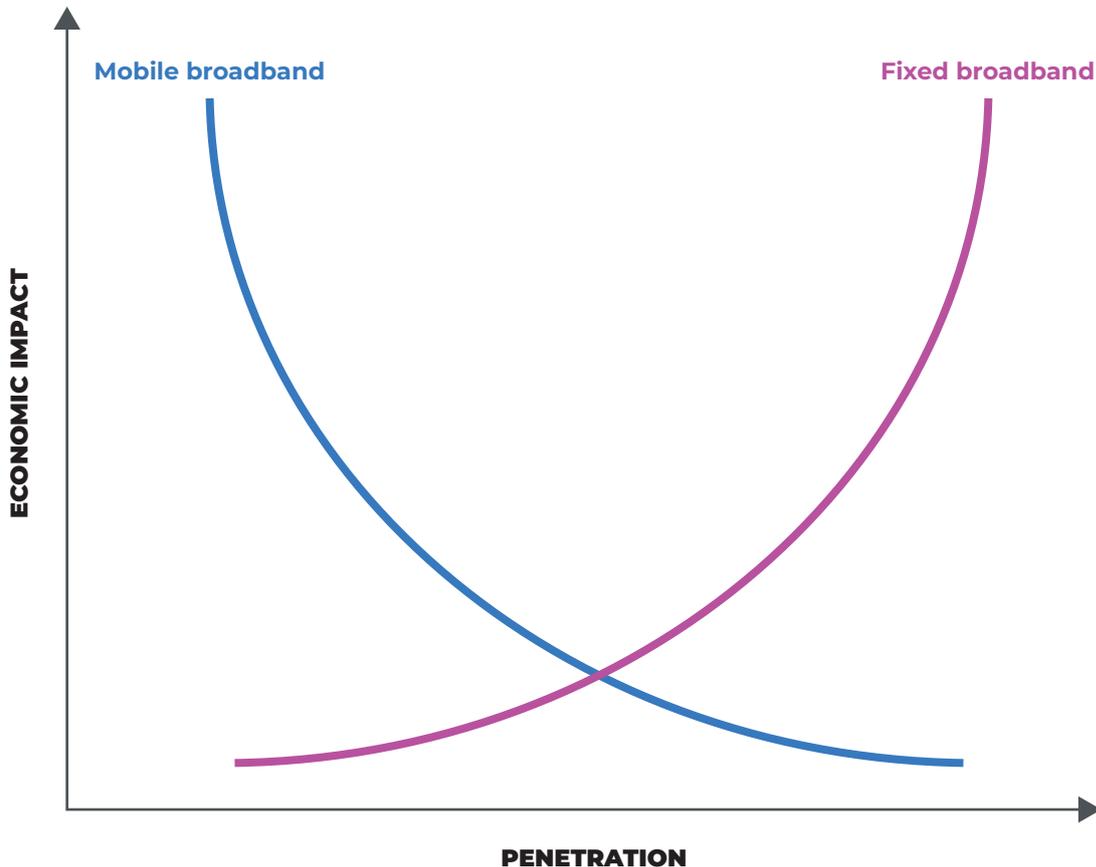
As detailed in the WBBA BCDI 2023 report, there have been several studies examining the correlation between fixed broadband penetration and GDP, including the International Telecommunication Union (ITU)'s *How broadband, digitization and ICT regulation impact the global economy* report published in November 2020. The report, which is based on an econometric analysis of 139 countries from 2011 to 2017, found that across all the countries, a 10% increase in fixed broadband penetration will lead to a 0.77% increase in GDP per capita.

The research also finds that the impact of higher fixed broadband penetration is much greater in countries with higher GDP per capita. The ITU finds that in countries with GDP per capita over \$22,000, a 10% increase in fixed broadband penetration increases GDP per capita by 1.4%. In contrast, in countries with a GDP per capita below \$12,000, the same increase in fixed broadband penetration has no impact on GDP per capita.

This is not to say that broadband overall does not have a positive impact in countries with relatively low GDP per capita. The ITU also researched the impact of mobile broadband penetration on GDP per capita and found that it can be seen as complementary to the economic impact of fixed broadband penetration. This is because increasing mobile broadband penetration has a bigger economic impact in countries with lower GDP per capita and a smaller impact as GDP per capita increases.

There are several reasons for this, the ITU finds, with one being that mobile broadband penetration has a bigger impact in countries with lower GDP per capita because fixed broadband penetration tends to be low in those countries. This means that mobile broadband is the only or main option for connectivity, which leads it to have a bigger economic impact. In contrast, countries with higher GDP per capita typically have high penetration of both fixed and mobile broadband services, so the economic impact of mobile broadband suffers from diminishing returns, partly owing to competition from fixed broadband services (**Figure 1**).

FIGURE 1: ECONOMIC CONTRIBUTION OF MOBILE VERSUS FIXED BROADBAND



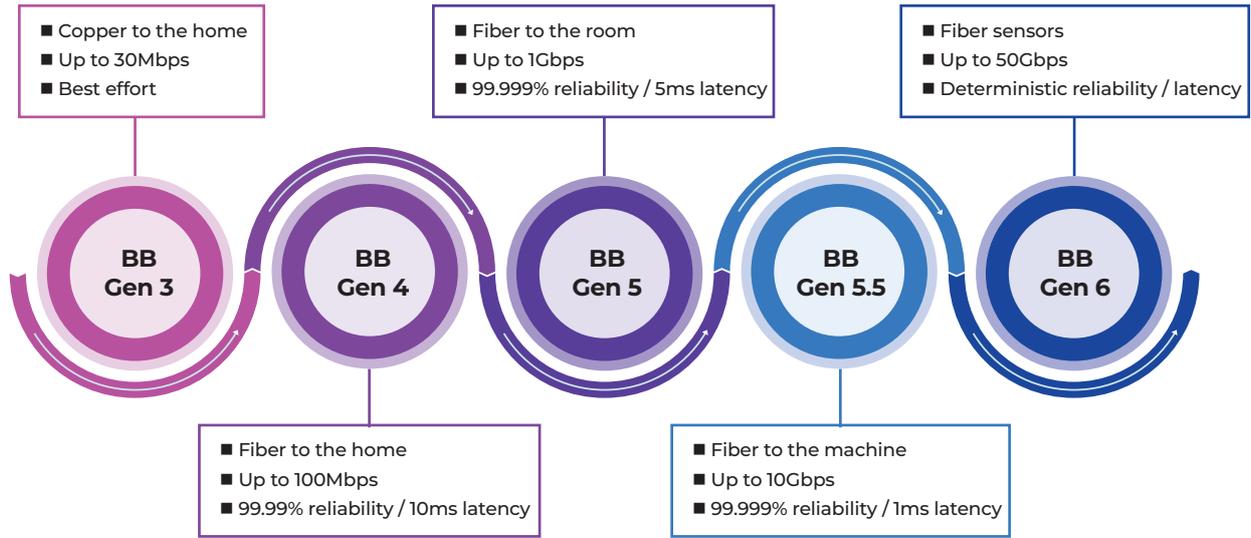
SOURCE: ITU

This shows both the importance of the different types of broadband and their complementary economic impact. It also helps to explain why the WBBA's BCDI focuses only on the fixed broadband market (including fixed wireless) rather than on both the fixed and mobile broadband markets. As **Figure 1** illustrates, as fixed broadband penetration increases, it has a bigger positive impact on the economy, in part owing to the myriad applications and services enabled by advanced broadband networks. Those applications and services are also rapidly migrating to the cloud, which is the other key component of the BCDI.

TECHNOLOGY INNOVATION

With the transition to advanced FTTH services well underway, it is important to note that this is just one phase of broadband industry development, with more to come. In fact, the WBBA has created a roadmap to show how it expects broadband technology to continue to evolve through several generations, starting with the migration currently underway from Broadband Generation 3 (BB Gen 3) based on copper technologies, such as DSL to Generations 4 and 5 based on fiber (**Figure 2**).

FIGURE 2: THE TRANSITION TO BROADBAND GENERATIONS 4 AND 5 IS UNDERWAY IN BCDI COUNTRIES



SOURCE: NEXT-GENERATION BROADBAND ROADMAP 2023 TO 2030, WBBA

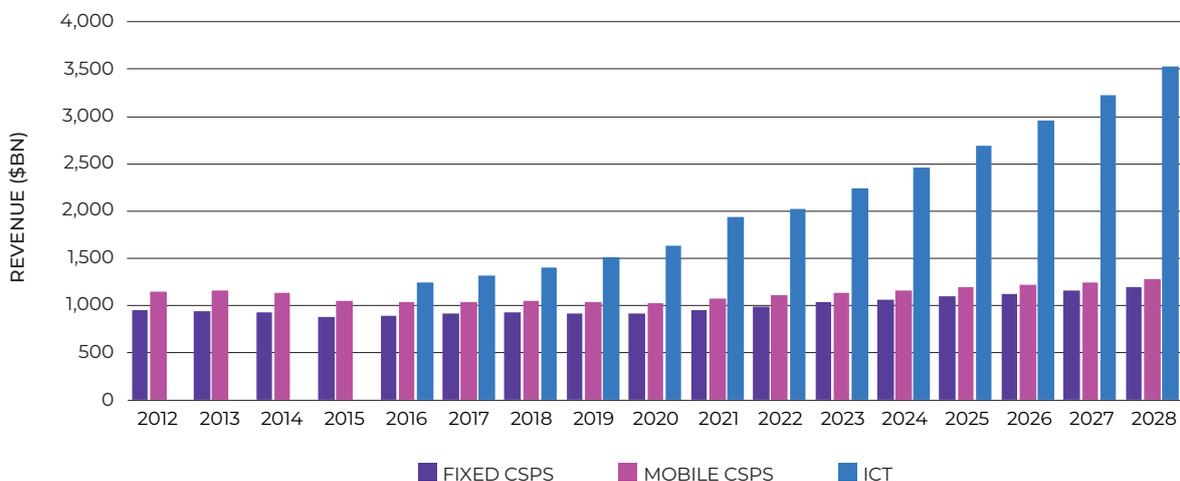
As seen in later sections of this report that analyze BCDI results, countries that are more advanced in the transition to fiber broadband services tend to score higher not only in the broadband segment of the BCDI but also in the cloud. That supports the argument that the benefit of broadband services extends well beyond their direct economic impact because they are the foundations of the digital economy. Thus, they create value and enhance productivity across many other industries that rely on digital connectivity.

TELCO TRANSFORMATION

While broadband technology is a vital part of the industry, it and all the other aspects of the business must be harnessed to deliver adequate returns to shareholders, and telecom operators have struggled to achieve this fundamental economic goal. This has led to increasing pressure from shareholders for telcos to adopt new business models to generate more value and better returns.

At the same time, telcos have seen their core markets mature to the point where growth prospects are limited, particularly compared with adjacent markets, such as information and communications technology (ICT) (Figure 3).

FIGURE 3: TELECOM AND ICT GLOBAL REVENUES, 2012-28



SOURCE: OMDIA

CLLOUD-NETWORK CONVERGENCE

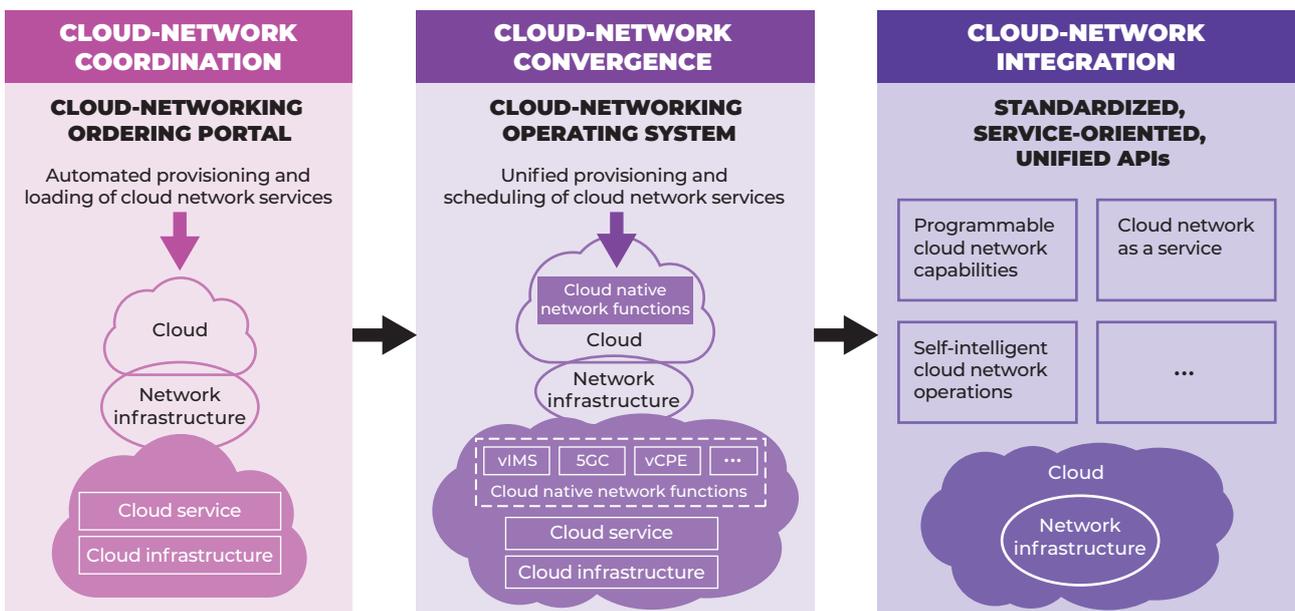
One strategy for telcos to improve their competitiveness and tap into the booming ICT markets is to converge communications networks and the cloud, a concept known as cloud-network convergence. This could potentially reduce network costs and improve services by supporting enterprise and consumer demand for real-time network connectivity, service agility, and multi-cloud collaboration. As a result, it could improve performance in the broadband and cloud markets, helping countries achieve higher BCDI scores.

In fact, backers of cloud-network convergence argue that the accelerating broadband-enabled digitization of economies is driving performance requirements that make it imperative that service providers deeply integrate the key networks supporting digital services. As detailed in WBBA’s *Driving the Future: Understanding the Landscape of Cloud Network Convergence* report, traditional cloud networks struggle to meet the requirements of advanced digital services for high performance and ultra-low latency. This has led service providers to explore the transformation of their IP and optical networks along with the use of AI-enabled network automation to drive cloud-network convergence.

One of the key technological developments in cloud-network convergence is the transformation of the traditional three layers of network infrastructure—focused on access, aggregation, and core, respectively—into two layers focused on a basic resource layer and the cloud. This transition, which involves a comprehensive cloud transformation of the network, typically happens in the following three phases:

- **Cloud-network coordination:** In this phase, cloud and network resources remain relatively independent, but initial integration in the infrastructure layer enables automated provisioning and loading of cloud and network services. This can be achieved through a new cloud-network ordering portal for customers.
- **Cloud-network convergence:** Here, cloud and network systems gradually converge through the adoption of a logical architecture based on common components, enabling deep integration of resource management and service scheduling. This supports unified provisioning and scheduling of cloud-network capabilities through a new cloud-network operating system.
- **Cloud-network integration:** In this phase, the technical boundaries between the cloud and the network disappear across infrastructure, underlying platforms, application architecture, development methods, and operational maintenance tools. As a result, cloud and network resources and services become standardized components of a single digital platform. The integration provides both applications and customers with a more seamless experience across computing, storage, and network resources.

FIGURE 5: THE THREE PHASES OF CLOUD-NETWORK EVOLUTION



SOURCE: CHINA TELECOM

Other key technical features of cloud-network convergence include:

- **Intracloud network integration:** The initial phase of cloud-network convergence, termed intracloud network integration, happened within data centers (DCs) between different cloud networks. To meet the demand for ultrafast, high-frequency transmission of massive amounts of data between cloud network, intracloud integration enables automated deployment, operations, and maintenance of the virtual cloud network of a DC through consistent security and network policies for container and virtualized service applications. Specifically, Spine-leaf/Clos architecture and Layer 2 network technology were introduced to integrate network and cloud capabilities in DCs.
- **Inter-data center traffic:** Intracloud network integration within DCs is not enough, given the number of DCs worldwide and the even larger number of cloud networks they support. That necessitates a focus on improving data center interconnection (DCI) to support the dramatic increase in inter-DC traffic. That, in turn, requires deploying DCI networks that are large capacity and nonblocking with low latency.
- **Cloud-to-cloud edge integrations for cloud access:** It is now clear that different types of services require differentiated private line solutions for cloud access. For example, software-defined wide-area networks (SD-WAN) can enable simple, flexible, and low-cost cloud access between a company's headquarters and branch offices. Another example is the use of optical transport network (OTN) technology to access the cloud when an enterprise requires high-quality access with low latency and robust reliability. This leads to the need for committed bandwidth via OTN.

An example of these aspects of cloud-network integration comes from China Telecom, which has become the second-largest cloud provider in China. In its *Interim Report 2024*, China Telecom states that it built computing power interconnection networks with high throughput and low latency, notably latency of 1ms within cities, 5ms within regions, and 20ms between regions.

China, which ranks second in the BCDI, also provides evidence for the commercial potential for cloud-network convergence since all the country's telcos have seen positive financial results since moving into the cloud market, as detailed in the China case study in a later chapter. For example, in 2023, China Telecom saw its cloud business grow 68% in 2023, China Mobile 66%, and China Unicom 41%, compared with cloud market leader Alibaba Cloud, which saw growth of 36%.

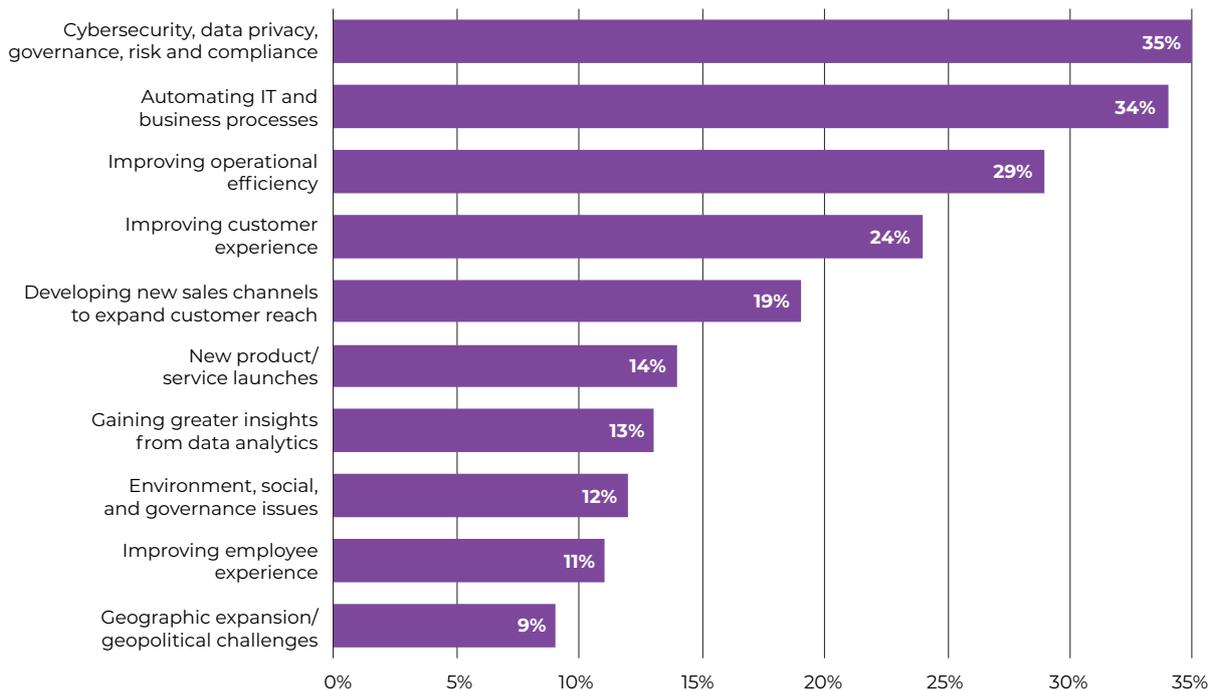
For telecoms service providers, other benefits of cloud-network convergence can include:

- Making telcos more competitive with cloud providers
- Intelligent, reliable, and always-on network connectivity
- Service agility, scalability, and flexibility to optimize business processes and revenue
- Faster time to market for new services
- Complete network visibility
- Integrated network and service security provisions
- Enhanced data protection, privacy, and data sovereignty
- A stronger foundation for developing AI, including AI-enabled intelligent network automation

CYBERSECURITY

Cybersecurity is one of the most important enablers of digitization, specifically in the development of the broadband and cloud industries. This is because it provides governments, enterprises, and individuals with the levels of security and privacy they need to continue expanding their digital activities. This helps to explain why Omdia's *Digital Enterprise Services Survey 2023 – Managed Cloud & Professional Services* of 359 respondents globally finds that cybersecurity, data privacy, and related areas are the top challenges for IT decision-makers (**Figure 6**).

FIGURE 6: ENTERPRISES SEE CYBERSECURITY, DATA PRIVACY, AND RELATED AREAS AS THEIR TOP CHALLENGES



Sample size: 359 IT decision-makers. Question: Which business/corporate challenges will your organization address as a priority in 2023–24?

SOURCE: DIGITAL ENTERPRISE SERVICES SURVEY 2023 – MANAGED CLOUD & PROFESSIONAL SERVICES, OMDIA.

Enterprises' focus on cybersecurity is understandable. According to Omdia's *Cybersecurity Decision Maker Survey 2023: Overall Findings*, 92% of organizations suffered some form of security incident or breach during the preceding 12 months. Furthermore, 47% of organizations had faced material impact from security incidents, and 38% of organizations suffered an incident costing upward of \$250,000 in response and remediation. As detailed in Omdia's *Omdia Predicts: Cybersecurity Trends Overview – 2024* report, failures in cybersecurity are clearly disruptive and expensive, which means it is likely to stay at the top of the list of enterprise IT priorities.

SUSTAINABILITY

The urgency of global environmental challenges, combined with evolving regulations and rising stakeholder expectations, is compelling enterprises to prioritize sustainability, driving the need for innovative, technology-driven solutions. In fact, Omdia's *IT Enterprise Insights Survey 2024* of 5,185 enterprises worldwide found that more than three-quarters of respondents stated that their organizations are committed to sustainability. In addition, the top sustainability programs that organizations focus on are product recovery and recycling, cited by 48% of respondents, followed by using renewable energy resources for powering facilities, cited by 46% of respondents.

When survey respondents are narrowed down to 181 fixed and broadband service providers worldwide, using renewable resources for powering facilities is the joint top answer cited by 50% of respondents, sharing the top spot with product recovery and recycling. That highlights that for digital industries, including broadband and cloud, one of the most important ways to improve the sustainability of services is to reduce the greenhouse gas emissions of energy consumption. That can be done through a combination of improving the energy efficiency of networks, often by migrating to more advanced technologies and reducing emissions by moving from energy based on fossil fuels to renewable energy sources, such as solar and wind.

The importance of this trend led the WBBA to add a new metric on sustainable energy to the latest BCDI.

APPLICATIONS AND SERVICES ARE DRIVING DEMAND FOR NEXT GENERATION BROADBAND

OVERVIEW

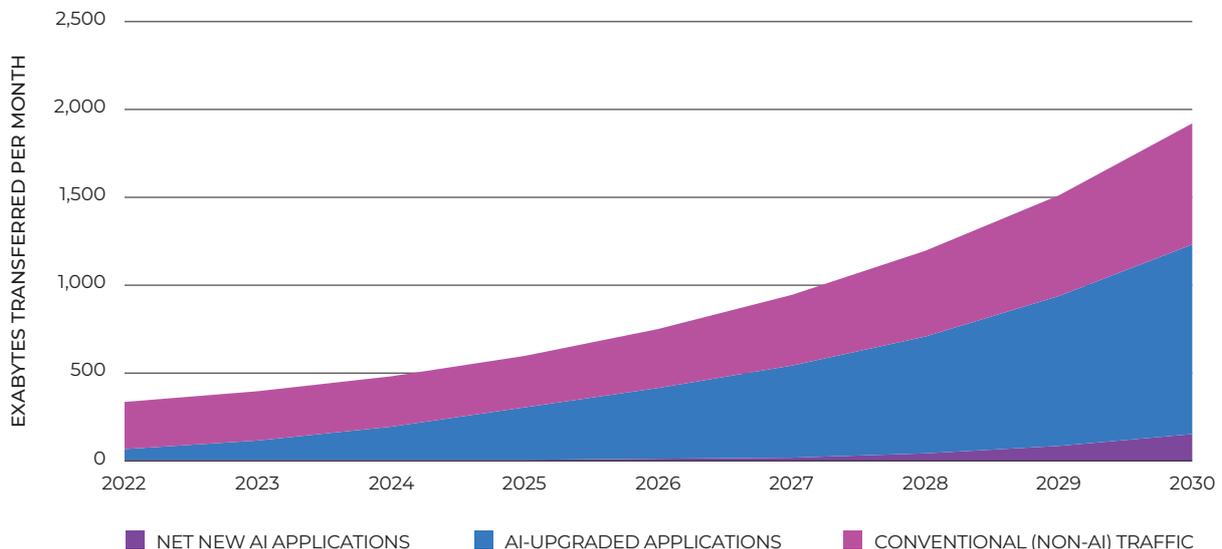
The widespread availability of broadband Internet has fueled a host of new innovative applications and services. This has created a demand for better and more widely available broadband access. From the rise of online search and streaming video to last year’s surge in the use of generative artificial intelligence (GenAI), digital applications and services are continuously transforming our businesses, economies, and societies.

AI ADOPTION

AI became widely accepted in 2023, and AI elements are increasingly finding their way into everyday applications. Despite the growing excitement about the technology’s almost limitless potential, there has been less focus on the significant impact that AI adoption will have on traffic levels on broadband, cloud, and transport networks.

Omdia’s *AI network traffic forecast, 2022–30* report predicts that by 2025, most network application traffic will involve AI content generation, curation, and/or processing. By 2030, nearly two-thirds of network traffic will involve AI, with the rapid growth of video and image content. These trends drive forward a historic 25% year-on-year (YoY) traffic increase from 2025 to 2030. Global networks supporting Exabytes today must soon carry Zettabytes. Network operators must be ready to support existing applications shifting into AI, as well as entirely new AI traffic (**Figure 7**).

FIGURE 7: PROJECTED GLOBAL NETWORK TRAFFIC GROWTH, 2022–30



SOURCE: OMDIA

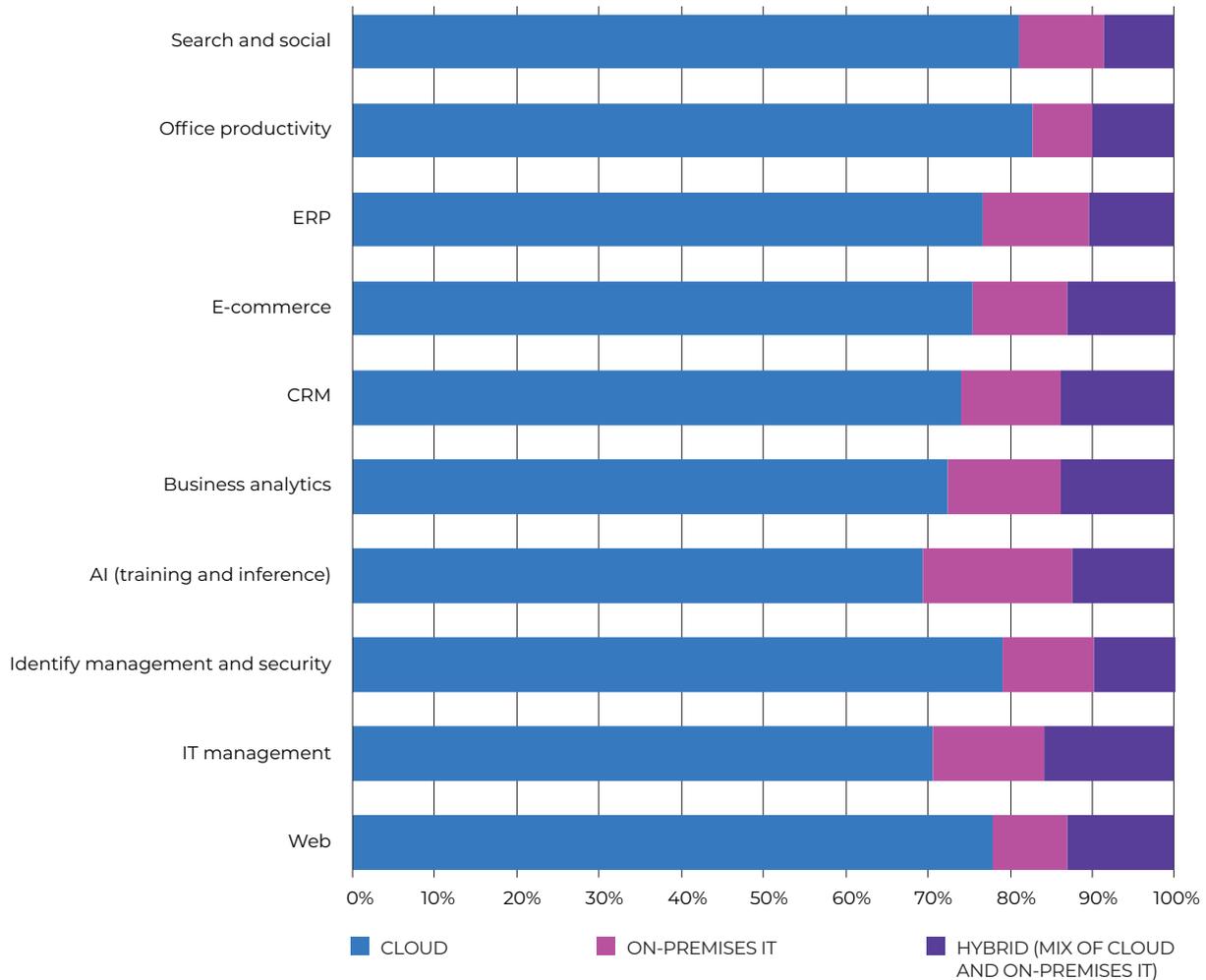
High-profile applications like ChatGPT (which generates deep learning-generated text) or NightCafe (which creates AI-generated artwork) are gaining traction. However, in terms of AI-driven new traffic volume, they are smaller players. Over the next four years, real-time video and high-resolution images will dominate new AI traffic. This will be driven by cameras and

devices, improved bandwidth and connectivity, and enabling applications. All the necessary components to build these solutions are already established, available, and attractively priced, which will drive their adoption and the resulting wave of AI network traffic. This, in turn, will place increasing demands on underlying broadband and cloud networks.

CLOUD COMPUTING

The widespread adoption of cloud computing is evident from Omdia's *IT Enterprise Insights Survey 2024*, which finds that the cloud is now the dominant method of delivering all categories of applications, based on the results from 1,764 enterprise respondents worldwide (**Figure 8**).

FIGURE 8: CLOUD HAS BECOME THE DOMINANT ENTERPRISE DELIVERY STRATEGY FOR APPLICATIONS



Sample size: 1,764. Question: What is your delivery strategy for applications now?

SOURCE: IT ENTERPRISE INSIGHTS 2024 SURVEY, OMDIA.

Enterprise respondents also expect a rise in cloud adoption over the next 18 months, largely at the expense of applications delivered by on-premises IT.

Although enterprise adoption of the cloud continues to grow, it is clearly now a more mature market. The focus has shifted from simply moving initial workloads to the cloud to a more complex consideration of hybrid environments. This includes addressing data residency and compliance, meeting low latency requirements for data-heavy applications that may require edge computing, and cost-effectively managing multiple hyperscalers' resources while minimizing lock-ins.

EDGE COMPUTING

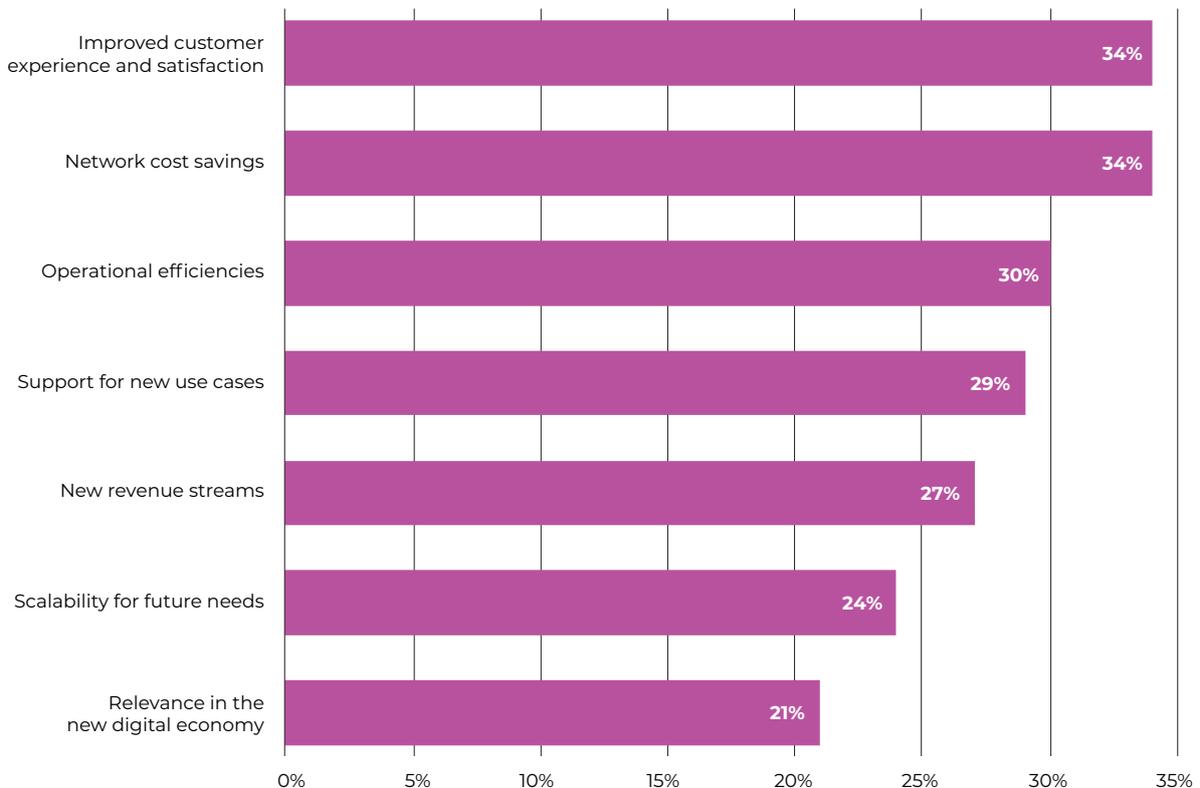
Despite a limited initial adoption of edge computing on telco networks over the last several years, telcos have consistently launched commercial products. They view the edge as an essential part of their overall cloud strategies, internally for telco cloud and externally for third parties.

According to an Omdia survey on edge computing, 56% of telcos have launched full commercial services with partnerships with hyperscalers, their own stacks, or both. Some 44% of respondents in the early phases of deployments are set for full launches within the next two years.

In the last couple of years, edge computing has become less and less of a “thing” to sell, and more of a position on the cloud continuum that fills specific customer requirements, such as data privacy, network savings, connection reliability, low latency, or control. Because of this, while the number of explicit edge-related launch announcements has dwindled, the importance of the concept has remained alive—and perhaps renewed, thanks to advances in and expectations from AI workloads.

Omdia’s survey also revealed that the appeal of edge computing comes primarily from its versatility. As a topology driven by cloud-native principles for network functions and IT workloads, it offers telecom operators significant internal and external benefits. While network cost savings, operational efficiencies, and scalability are more internally focused, better customer experience, as well as new use cases and revenue streams, stand out as more external-oriented incentives (**Figure 9**).

FIGURE 9: TELCOS CITE A WIDE RANGE OF REASONS FOR DEPLOYING EDGE COMPUTING



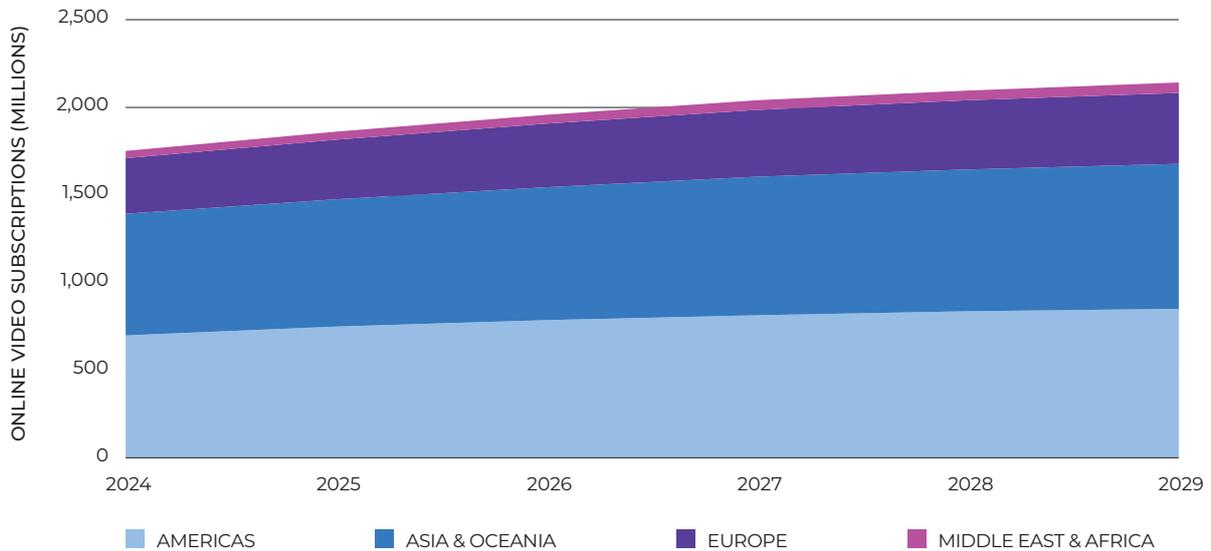
Sample size: 135. Question: What are the biggest incentives for your organization to deploy edge computing?

SOURCE: CSP EDGE COMPUTING SURVEY 2024, OMDIA.

ONLINE VIDEO SERVICES

Cloud-based video services, such as Netflix and Amazon Prime, are leading drivers of traffic on fixed (and mobile) broadband networks, which is why the WBBA has included metrics in the BCDI for online video users and online video views. Omdia forecasts the online video market will continue to see robust growth, with more than 2 billion subscriptions worldwide by 2027 (**Figure 10**)

FIGURE 10: ONLINE VIDEO SUBSCRIPTIONS BY REGION, 2024–29



SOURCE: OMDIA

However, the business models for online videos are evolving. Providers are moving from a historical focus on subscription models to also embracing advertising options. For example, Netflix, the segment's largest provider, has built an enormous subscriber base using the SVOD model. However, as its subscription numbers began to decline in 2022 and show signs of maturity, the company started exploring other options beyond SVOD.

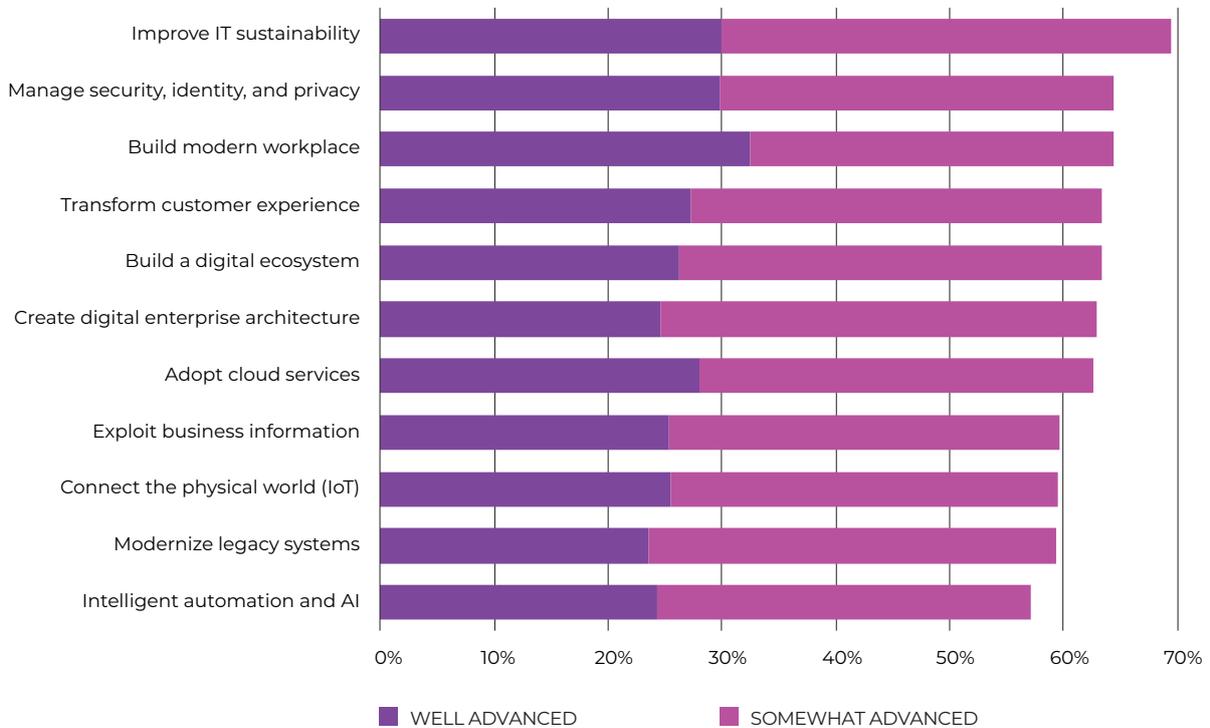
It has, therefore, started to include some ad-supported options in its service. This strategy is potentially risky because a big part of its appeal was providing ad-free TV and movie viewing. Conversely, with the rising cost of living, offering new lower-cost hybrid prices will also give customers a new option. This move will help retain existing customers who might have otherwise left entirely.

Regardless of the success of Netflix's latest strategic move, the strong demand for online video services will continue to drive massive levels of network traffic, which in turn will drive innovation and development of broadband and cloud services.

DIGITAL TRANSFORMATION

Digital transformation has become an ongoing priority for enterprises as they work to digitize more business processes to reduce costs, increase flexibility, and support the launch of new digital services. In fact, Omdia's *IT Enterprise Insights Survey 2024* of 5,185 enterprises worldwide revealed that most respondents reported that their companies are well or somewhat advanced across all aspects of digital transformation (**Figure 11**).

FIGURE 11: MOST ENTERPRISES ARE SOMEWHAT TO WELL ADVANCED WITH DIGITAL TRANSFORMATION



Sample size: 5,185. Question: How advanced is your digital transformation around each of the above areas?

SOURCE: IT ENTERPRISE INSIGHTS 2024 GLOBAL SURVEY, OMDIA.

As suggested by the wide variety of areas above, digital transformations are often large and multifaceted projects that are reasonable indicators of the state of digitization of enterprises. Digitization, in turn, is one of the core drivers of demand for broadband and cloud services.

METaverse APPLICATIONS

The metaverse and extended reality (XR) are the next generation of the Internet, as detailed in WBBA's *The impact on broadband networks when deploying metaverse applications at scale* whitepaper. In the future, there should be as many metaverse and XR applications and use cases as there are mobile applications today. However, consumer adoption remains low partly because of the relatively expensive and sometimes cumbersome to wear XR-related hardware, as well as a lack of attractive content. Currently, gaming is the most popular use case.

As hardware becomes cheaper, smaller, and lighter, we can expect new innovations in consumer applications that will drive overall demand. According to Omdia's *Consumer VR Headset and Content Revenue Forecast*, global hardware sales for consumer virtual reality (VR) will increase from \$4bn in 2024 to \$14bn in 2028, more than tripling in value.

The use cases for XR in enterprises are much clearer. Most enterprises are already able to identify compelling uses for XR, and many are investing in it. According to Omdia's enterprise survey data, nine out of ten enterprises can identify compelling use cases for XR services, and almost 20% of enterprises are already investing in them. Key areas of interest include safety, efficiency, compliance, and training or insights, but there are many more. Today, the usage of

XR is limited to specific expert roles rather than being rolled out to all employees, but over time, the technology will become more widely used.

XR applications vary in complexity, with more advanced applications being computationally heavy. As the demand for smaller and lighter devices increases, more of this processing will be shifted into the cloud, placing greater requirements on local, access, and core networks.

The WBBA has set out its broadband generation roadmap, which broadly aligns with the infrastructure requirements set by the Metaverse Standards Forum, especially for mass-market metaverse adoption. It is clear that to prevent more developing countries from being left behind in the move to next-generation Internet applications and all the associated socioeconomic benefits, countries must establish investment, legislation, and deployment plans and targets that facilitate the transition to advance all-fiber broadband networks outlined in the WBBA's roadmap.

BCDI 2024: OVERVIEW AND METHODOLOGY

OVERVIEW

The BCDI tracks and benchmarks the development of the fixed broadband and cloud computing industries by country. Research conducted by the ITU and others has shown that increasing broadband penetration and digitization drives socioeconomic benefits, such as GDP and productivity growth. This explains why the BCDI aims to quantify the performance of broadband and cloud markets by country and to identify global best practices for developing these two key drivers of digital development. This, in turn, will enable broader economic and social benefits.

As such, the BCDI measures a country's ability to narrow the digital divide and make the most of the opportunities offered by the digital economy. Its findings can help service providers plan their strategies for developing and investing in broadband and cloud networks in a country. Additionally, it identifies best practices and government policies that support the growth of these industries and the broader economy.

The BCDI is designed to identify best-in-class performance at the country level, highlight the most critical drivers for the continued development of the sector, and make clear the investment case for broadband and cloud infrastructure. The aim is to provide new insight, analysis, and examples for broadband industry stakeholders, whose constituents include legislators, policymakers, investors, vendors, service providers, and enterprises, to address and drive forward the goals of democratizing broadband and cloud access to enable broader economic and social benefits.

ENHANCEMENTS TO BCDI 2024

Following the successful launch of the BCDI last year, the WBBA is committed to expanding the geographic coverage of the index to significantly increase its scope and relevance for regulators, service providers, and suppliers worldwide. As a result, the 2024 edition of the BCDI includes 62 countries, up from the 21 countries covered in the inaugural BCDI in 2023. This means that the countries in the BCDI now account for more than 90% of global GDP, compared with nearly 75% in 2023, and over 75% of the world's population, up from closer to 50% in BCDI 2023.

Another improvement to BCDI 2024 to ensure the index accounts for more key aspects of the broadband and cloud industries is the addition of three new metrics. The new metrics and the reasons for their inclusion are as follows:

- **AI adoption:** AI has the potential to transform the broadband and cloud industries, so the WBBA felt it was important to add a metric on the adoption of this vital new technology.

- **Data center investment:** Since data centers are the foundations of cloud services, the WBBA decided to include a metric on the level of investment in these core platforms.
- **Sustainable energy:** Sustainability is increasingly important to the broadband and cloud industries, which led the WBBA to develop a metric on sustainable energy to include in BCDI 2024.

Aspects of the BCDI methodology have also been updated to improve scoring across all the countries. Several metrics have been revised to improve normalization to country size, to ensure metrics and scores are not biased owing to the very different sizes of countries in the index. For example, spending metrics in the cloud segment, including cloud spending, storage spending, PaaS spending, and SaaS spending, are based on average enterprise spending in each area in each country. Using these metrics means they are comparable across different countries no matter their size, as opposed to metrics for total spending by segment across all enterprises in a country.

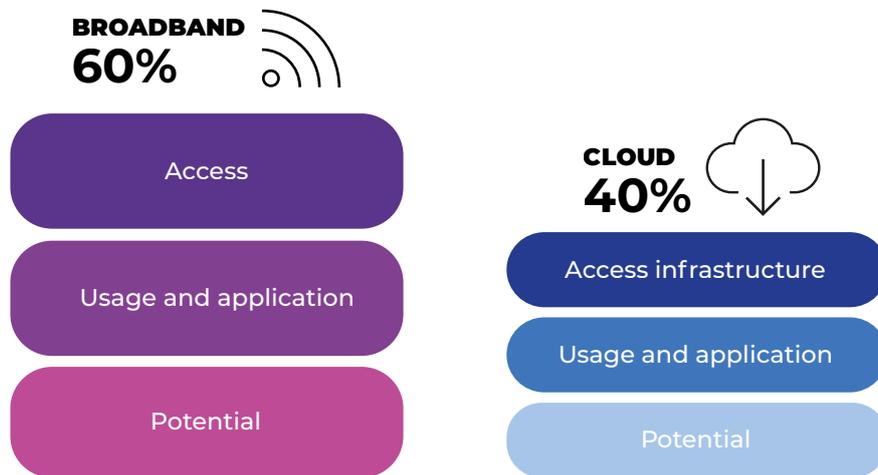
The many improvements to BCDI 2024, including the significant increase in country coverage, addition of new metrics, and methodology improvements, also mean that the detailed country scores in BCDI 2024 are not directly comparable to those in 2023.

METHODOLOGY

The BCDI examines the development of fixed broadband and cloud markets across 62 countries worldwide, representing over 75% of the world’s population and more than 90% of the global GDP. In finalizing the expanded geographic scope of the second edition of the BCDI, the WBBA included those countries where it had access to enough high-quality data to develop a robust index quantifying the performance of the broadband and cloud markets.

The BCDI is designed to assess the overall performance and impact of the broadband and cloud markets by examining them across three key areas, which are access, usage and application, and potential (**Figure 12**).

FIGURE 12: BCDI COVERAGE AND WEIGHTING BY MARKET



SOURCE: WBBA

The relative sizes of the broadband and cloud boxes in **Figure 12** reflect the WBBA’s view that broadband, as the gateway to the digital economy, is more important than the cloud. This view led WBBA to use a methodology with index weightings of 60% for broadband and 40% for cloud.

As the segmentation in **Figure 12** shows, the BCDI takes a holistic view of broadband and cloud, starting with the initial access stage of evaluating the availability of services, then the usage and application of services, and finally, to their potential going forward.

The first step in quantifying the impact of each segment in each market is the selection and validation of the most relevant high-quality input metrics available for all 62 countries in the index. Overall, the BCDI is based on 28 metrics in total, with four to five metrics in each segment. This adds up to 13 metrics related to the broadband market and 15 metrics on the cloud. The main source of these metrics is Omdia, a WBBA member, and Ookla, another WBBA member, which provided data for two of the broadband metrics.

BROADBAND METRICS

In the fixed broadband market, the BCDI is built on thirteen metrics (**Table 1**), with four to five metrics evaluating each of the three key areas, which are broadband access, usage and application, and potential.

TABLE 1: BCDI BROADBAND METRICS BY SEGMENT

SEGMENT	METRIC	DEFINITION
ACCESS	Residential broadband penetration	The number of residential broadband subscriptions divided by the number of households.
	Total (residential and business) broadband penetration	Total number of residential and business subscriptions divided by total number of households.
	FTTH coverage	The number of residential households covered by the optical fiber network divided by the total number of households.
	FTTH penetration	The number of FTTH broadband subscriptions divided by the total number of households.
USAGE AND APPLICATION	Median download speed	Median download speed of fixed broadband services, based on one month (May 2024) of aggregated Speedtest Intelligence data provided by Ookla.
	High-speed broadband penetration	The proportion of households with broadband subscription tariffs providing 500Mbps or faster download speeds.
	Online video user penetration	The number of paying subscribers and free trialists across online video platforms (e.g., Netflix and Amazon Prime) divided by the population of the country.
	Online video views per capita	Total transactional, ad-supported, and subscription views and transactions of content across pay TV and online video subscription services divided by the population of the country.
POTENTIAL	Market competition	One minus the Herfindal-Hirschman Index (HHI) score for the fixed broadband market. The HHI measures the level of concentration within a market and, therefore, the level of competition. It considers two main factors: the number of companies and the market share of each company in that market. The index varies from 0 to 100%: the closer to 100%, the more concentrated the market. For the fixed broadband market, HHI is calculated by taking the square of the market share of fixed broadband subscriptions of each company and adding them together.
	Incumbent impact	One minus the market share of the incumbent or largest broadband service provider.
	Provider penetration	The number of active internet service providers divided by the number of households. The number of ISPs is based on the Speedtest Intelligence data from the month of May 2024 provided by Ookla.
	Sustainable energy	Sustainable energy power capacity as a percentage of total national power capacity, based on data from independent energy think tank Ember.
	Broadband affordability	Annual GDP per capita divided by annual broadband ARPU.

SOURCE: OOKLA, EMBER, AND OMDIA

In the BCDI, fixed broadband services are defined as those delivered by either wired technologies (e.g., fiber or DSL) or fixed wireless technologies (e.g., 4G or 5G). Mobile broadband services delivered to a smartphone or handset via 4G, 5G, or another mobile technology are not covered in the BCDI.

CLOUD METRICS

The BCDI is based on 15 metrics evaluating the cloud market, with five each on cloud access infrastructure, usage and application, and potential (**Table 2**).

TABLE 2: BCDI CLOUD METRICS BY SEGMENT

SEGMENT	METRIC	DEFINITION
ACCESS	Cloud spending	The average enterprise spending on public cloud in 2023.
	Cloud spend proportion	The average enterprise cloud spending is a proportion of the average IT budget in 2023.
	Storage spending	Average enterprise spending on storage in 2023. Storage includes the following technologies: <ul style="list-style-type: none"> ■ Hard-disk drives: Standard hard drives that are used to augment or maintain storage area network (SAN) and network-attached storage (NAS) systems. ■ NAS filers and arrays: A NAS file server designed and programmed for high-volume data storage, backup, and archiving. ■ NAS gateways: A single gateway that consolidates and aggregates several NAS filers. ■ SAN adaptors and connectors: High-speed networking hardware that is optimized for storage network traffic (e.g., fiber channel). ■ SAN disk arrays: An enterprise storage system that contains multiple disk drives. It is differentiated from a disk enclosure in that an array has cache and intelligence. ■ Tape libraries: A high-capacity data storage system for storing, retrieving, reading, and writing multiple magnetic tape cartridges.
	Data center investment	Investment based on the sales of rack vendors to data centers in the country divided by country GDP.
	Data center load capacity	The maximum power available for IT and mechanical equipment in data centers as a proportion of the country's total power capacity.
USAGE AND APPLICATION	Average PaaS spending	Average enterprise spending in 2023 on PaaS services that combine application development tools, middleware, and runtime services delivered from, or integrated with, an IaaS platform that may or may not be separately available to customers. PaaS can be platform-centric (e.g., IoT or big data), application-specific (e.g., customer engagement or business intelligence), and is typically focused on developer tools and APIs. Customers pay for usage of the services without owning the underlying software licenses, and PaaS is designed to make it easier to develop, deploy, and manage applications and cloud-based resources (external spending).
	Average SaaS spending	Average enterprise spending in 2023 on a usage-based consumption model for runtime applications delivered over the Internet or accessed by private network services from multitenant cloud resources hosted externally either by an independent software vendor (ISV) or by a managed services provider. With SaaS, the service provider owns the software license, not the customer. This includes applications, such as sales, marketing, and customer service apps; finance, ERP, and SCM apps; productivity and collaboration apps; and industry-specific operations apps offered as a service (external spending).
	% of workloads in public cloud	The proportion of workloads in the public cloud in 2023. The public cloud is defined by IaaS, PaaS, and serverless services.
	% of workloads in SaaS	The proportion of workloads in SaaS in 2023.
POTENTIAL	Cloud spending growth	YoY change in average enterprise spending on public cloud (2023 vs. 2022).
	Storage spending growth	YoY change in average enterprise spending on storage (2023 vs. 2022).
	Growth in workloads in public cloud	The difference in the proportion of workloads in the public cloud between 2022 and 2024 (18 months).
	Growth in SaaS workloads	The difference in the proportion of workloads for SaaS between 2022 and 2024 (18 months).
	Share of largest cloud provider	The relative market share of the incumbent (or largest) provider based on enterprises that spend more than \$1m per year.

SOURCE: OMDIA

NORMALIZATION

After selecting, compiling, and validating the 28 metrics for the 62 countries in the Index, the next step in the methodology was to normalize all the metrics to a scale of 0 to 100. For metrics in percentages, such as penetrations, the first step in the normalization process is straightforward in that the percentages were simply multiplied by 100.

The next step in the process was min-max normalization, which converts each metric to a scale of 0 to 100. In practice, this means that the lowest value in each metric converts to 0, the highest value converts to 100, and each value in between is scaled to a value between 0 and 100. The min-max normalization puts all the metrics on the same scale of 0 to 100 so they can be compared and aggregated into index scores.

WEIGHTINGS

After all the metrics were normalized to a common scale, weightings were agreed to reflect the relative importance of each metric within its segment and each segment within the overall index. The most important decision in this regard was to assign the highest segment weighting of 25% to two broadband segments: broadband access and broadband usage and application. This decision was based on the fact that broadband, serving as the gateway to the internet, is fundamental to the digital economy and thus holds greater importance than the cloud, which relies on quality broadband connections to be effective (**Table 3**).

TABLE 3: BCDI METRIC AND SEGMENT WEIGHTINGS

SEGMENT	SEGMENT WEIGHTING IN BCDI	METRIC	METRIC WEIGHTING IN SEGMENT
BROADBAND ACCESS	25%	Residential broadband penetration	25%
		Total (residential and business) broadband penetration	25%
		FTTH coverage	25%
		FTTH penetration	25%
BROADBAND USAGE AND APPLICATION	25%	Median download speed	25%
		High-speed broadband penetration	25%
		Online video user penetration	25%
		Online video views per capita	25%
BROADBAND POTENTIAL	10%	Market competition	30%
		Incumbent impact	10%
		Provider penetration	10%
		Sustainable energy	10%
		Broadband affordability	40%
CLOUD ACCESS INFRASTRUCTURE	10%	Average cloud spending	25%
		Cloud spending proportion	25%
		Storage spending	25%
		Data center investment	12.5%
		Data center load capacity	12.5%
CLOUD USAGE AND APPLICATION	20%	Average PaaS spending	20%
		Average SaaS spending	20%
		% of workloads in public cloud	20%
		% of workloads in SaaS	20%
		AI adoption	20%

SOURCE: WBBA

TABLE 3: BCDI METRIC AND SEGMENT WEIGHTINGS (CONTINUED)

SEGMENT	SEGMENT WEIGHTING IN BCDI	METRIC	METRIC WEIGHTING IN SEGMENT
CLOUD POTENTIAL	10%	Cloud spending growth	20%
		Storage spending growth	20%
		Growth in workloads in public cloud	20%
		Growth in SaaS workloads	20%
		Share of largest cloud provider	20%

SOURCE: WBBA

Broadband potential was judged to be less important than the other two broadband segments, given that it is not focused on access and is more future-oriented. This led to a weighting of 10% for this segment. This, in turn, means that all three broadband segments have a combined weighting of 60%. Out of the three cloud segments, the cloud usage and application segment was judged to be the most important because it reflects enterprise spending on and use of cloud applications and services by country. As a result, this segment was given a weighting of 20%.

The other two cloud segments were both assigned a weighting of 10% but for different reasons. Cloud potential, as with broadband potential, was given a weighting of 10% because it is a more future-oriented segment. Cloud access infrastructure was also weighted at 10% because two of its metrics—data center investment and data center load capacity—are relevant not only to individual countries but also to the regional and global markets that can be served by the cloud infrastructure in those countries. Because the focus of the BCDI is to rank nations, this led to a lower weighting of 10% for this segment, as its data center metrics can be significantly influenced by the fact that data centers can serve international markets. Overall, these three cloud segments have a combined weighting of 40%.

As detailed in **Table 3**, metrics were also assigned weightings within their segment. Most metric weightings within each segment have been assigned equally, except for the broadband potential and cloud access infrastructure segments. In broadband potential, broadband affordability was seen as the most important of the five metrics impacting the potential of broadband, so it was given a weighting of 40%, followed by market competition at 30%. The other three segments were assigned weightings of 10%. However, it is important to note that for the sustainable energy metric, its 10% weighting is largely because the data available for the metric is on national sustainable energy rather than sustainable energy, specifically in the broadband and cloud industries.

In the cloud access infrastructure segment, the two metrics focused on data centers were given a lower weighting of 12.5% each because data centers in a country often serve international and national markets. The other three metrics in the segment were each assigned a weighting of 25% because they reflect average enterprise spending by country on cloud and storage.

COUNTRY INDEX SCORES

The next step in the methodology was to calculate country index scores for each of the six segments by multiplying the score for each metric times its weighting within the segment and adding the result for all the metrics in a segment to get a total score in that segment. Each segment score is then multiplied by the weighting of that segment within the index to create a total index score for each country.

VALIDATION

The validation of the index results was extensive and included sensitivity analysis to assess the validity of the results. This involved several approaches, such as adjusting the metrics in the index, determining the relative weightings of the metrics, and refining the methodology for

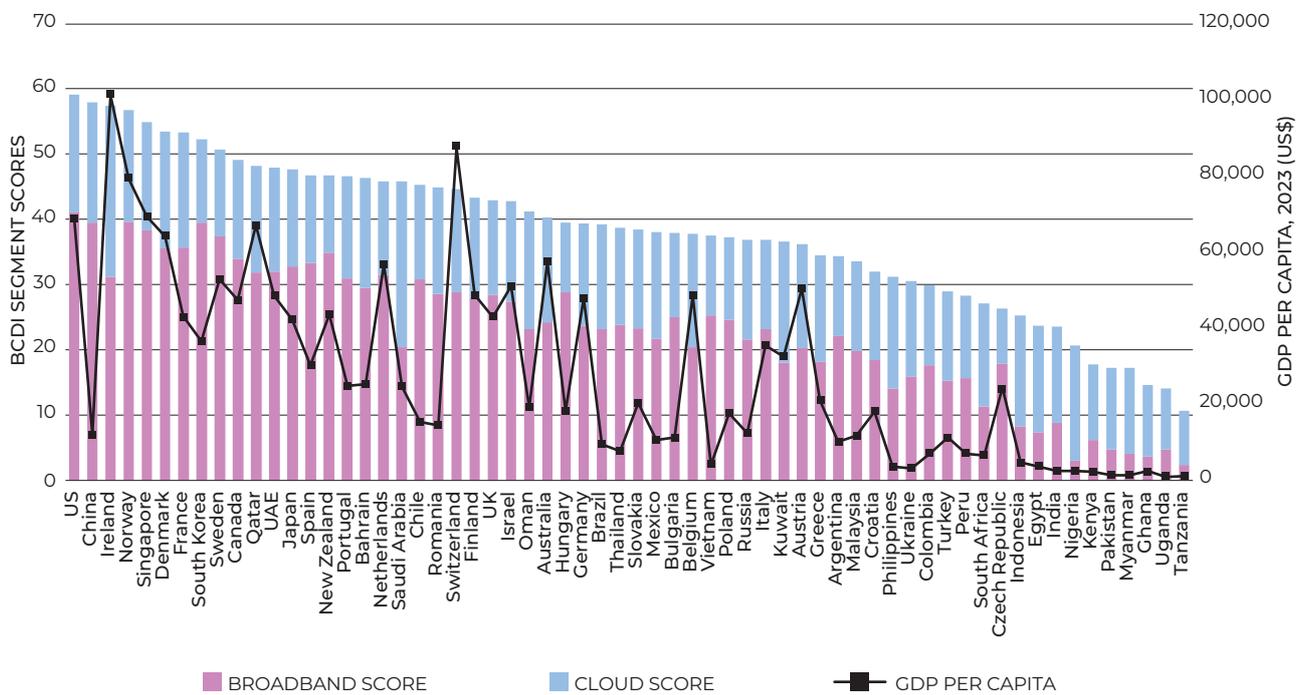
calculating scores. This is to gauge the sensitivity of the model to the changes and to arrive at the final methodology that produces the most robust results.

BCDI 2024: RANKING RESULTS

This chapter presents the results of the BCDI, including the overall score and ranking for each of the 62 countries. It is worth noting that the intent of the index is not to criticize countries based on their ranking but rather to identify best practices in countries throughout the index. This information can then be used by all stakeholders to improve the performance of the broadband and cloud markets in their countries.

The high-level results of the BCDI are provided in **Figure 13**, which indicates the overall BCDI scores by country, the separate contributions of the broadband and cloud segments, and the GDP per capita of each country.

FIGURE 13: BCDI RANKINGS, SEGMENT SCORES, AND GDP PER CAPITA



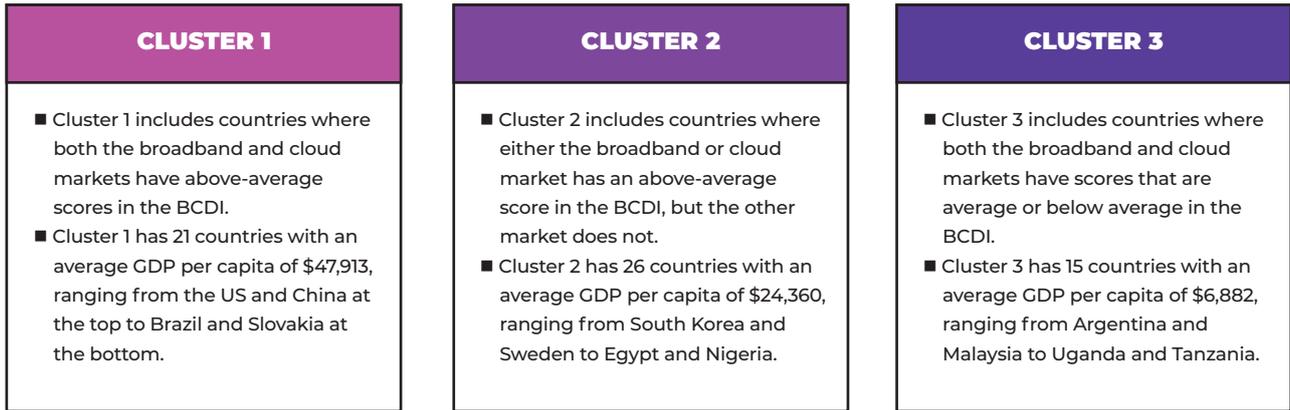
SOURCE: WBBA AND S&P GLOBAL INTELLIGENCE (GDP PER CAPITA)

The chart clearly shows a correlation between BCDI scores and GDP per capita by country. In statistical terms, there is a 73% positive correlation between the two, indicated by a correlation coefficient of 0.73. While this relatively strong positive correlation validates the methodology and results of the BCDI, the wide range of the relationships between BCDI scores and GDP per capita in individual countries could also uncover best practices for supporting the development of broadband and cloud at all stages of economic development.

Although analysis of selected countries will be provided in the next chapter, it is difficult to directly compare the results of one country to another, given the wide variety of countries in the index, their different stages of development, and the many unique characteristics of their broadband and cloud markets.

Therefore, to compare results at a higher level, the following sections organize BCDI countries into three different clusters (**Figure 14**).

FIGURE 14: BCDI COUNTRY CLUSTERS



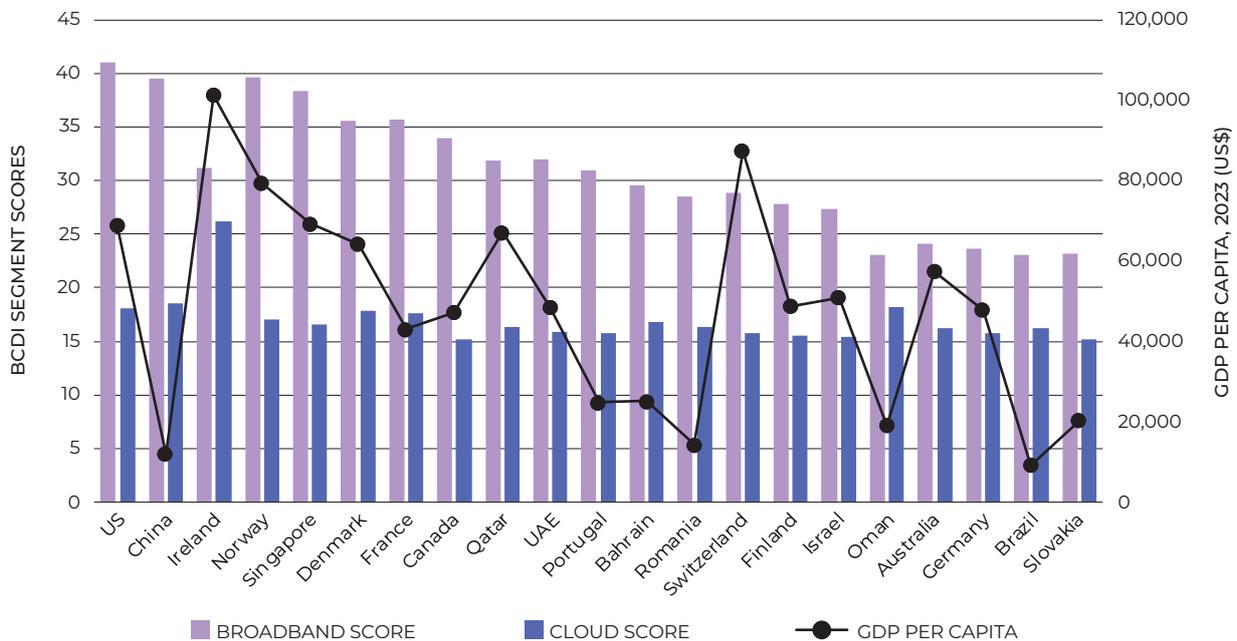
SOURCE: WBBA

It should also be noted that the larger number of countries in the BCDI in 2024 means there is a relatively wide range of scores across the countries in each cluster. For example, in Cluster 2, which is the largest cluster, broadband scores range from a high of 39.45 to a low of 2.98, while cloud scores range from 25.37 to 10.7. That shows that the clusters are broad groupings with similarities across countries but also significant differences, all of which can be useful for analysis.

CLUSTER 1

The 21 countries in Cluster 1 have economies that tend to be highly developed, large, or both (Figure 15).

FIGURE 15: BCDI CLUSTER 1 COUNTRIES, SEGMENT SCORES, AND GDP PER CAPITA



SOURCE: WBBA AND S&P GLOBAL INTELLIGENCE (GDP PER CAPITA)

The US and China lead the cluster and overall BCDI rankings. These countries will be covered in the country case studies in the next chapter. Ireland holds third place in the cluster and in the overall BCDI rankings owing to its top score in the cloud segment, which is in turn driven by leading scores in cloud usage and application and cloud access. Although Ireland’s high score in cloud access is likely driven in part by its role as a key data center location serving Europe and the world, its strong performance in cloud usage and application is driven by relatively high

average spending by Irish enterprises on PaaS and SaaS. Ireland also benefits from having the highest real GDP per capita (\$101,195) among all the countries in the BCDI.

In Cluster 1 countries, there is more variation in broadband scores compared with cloud scores. This suggests that even for most countries with the highest BCDI scores, investing in high-quality broadband access is the best way to increase their BCDI score. Therefore, investing in broadband should arguably be their top priority, followed by cloud investments.

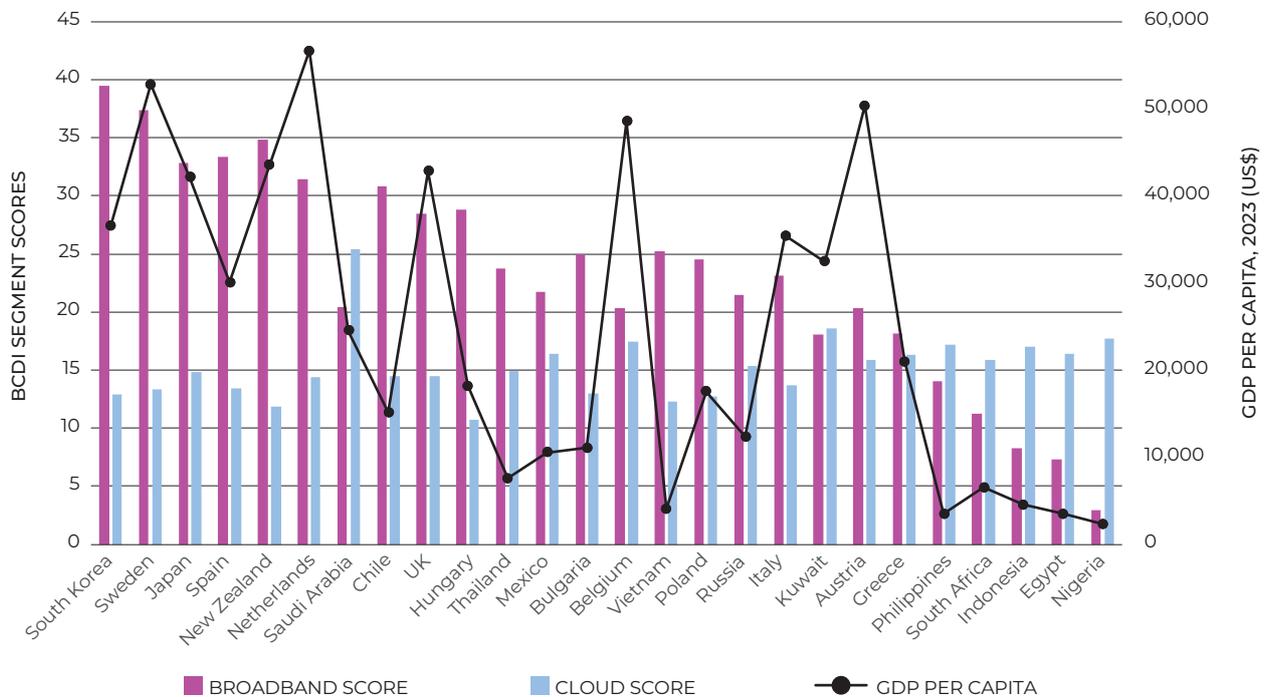
In addition to China, several other countries in Cluster 1 have relatively low GDP per capita, namely Romania, Oman, Brazil, and Slovakia. Despite their many differences, one commonality they share is relatively high fiber broadband coverage and adoption compared with other countries in the BCDI. For example, Brazil may have the lowest GDP per capita of Cluster 1 countries at \$9,309, but 67% of households in the country have access to fiber broadband services, and 38% have adopted the services. The other Cluster 1 countries with relatively low GDP per capita are similar in that fiber broadband services are available to most of their households. This suggests that government and industry support for investment in fiber broadband is one of the best ways for countries to develop both their broadband and cloud markets, irrespective of the country’s level of economic development.

The countries in Cluster 1 are prime candidates to integrate their cloud and broadband networks, a process sometimes referred to as cloud network convergence. This is because they already have advanced broadband and cloud networks and leading technical capabilities, which are essential for cloud network convergence.

CLUSTER 2

Cluster 2, the largest of the three clusters, includes 26 countries with one market segment scoring above-average and the other scoring average or below-average (**Figure 16**).

FIGURE 16: BCDI CLUSTER 2 COUNTRIES, SEGMENT SCORES, AND GDP PER CAPITA



SOURCE: WBBA AND S&P GLOBAL INTELLIGENCE (GDP PER CAPITA)

Based on **Figure 16**, most of the first 18 countries in the cluster, from South Korea to Italy, have above-average broadband scores and below-average cloud scores. In contrast, the last eight countries, from Kuwait to Nigeria, all have above-average cloud scores and below-average broadband scores.

The first five countries in the cluster, from South Korea to New Zealand, all have fiber broadband services with extensive coverage. This has led to the adoption of fiber services in the majority of households in each country. For these countries, unlocking the potential of the cloud market is a logical priority for development, with potential approaches including government and regulatory support, industry and service development, and technology innovation. Because these countries have highly-developed broadband markets, advanced technical capabilities, and relatively high GDP per capita, they are also leading candidates for cloud network convergence, as that could leverage the strength of their broadband networks and services to accelerate the development and growth of cloud services.

The Netherlands and Saudi Arabia differ from the first five markets in the cluster in that fiber broadband services are available to most households, but in both countries, less than 30% of households have subscribed to fiber services. That indicates that accelerating the adoption of fiber broadband should be a priority in both countries. Based on their scores in other metrics, both have room for improvement in the speed of broadband services. Additionally, affordability is a challenge in the Netherlands.

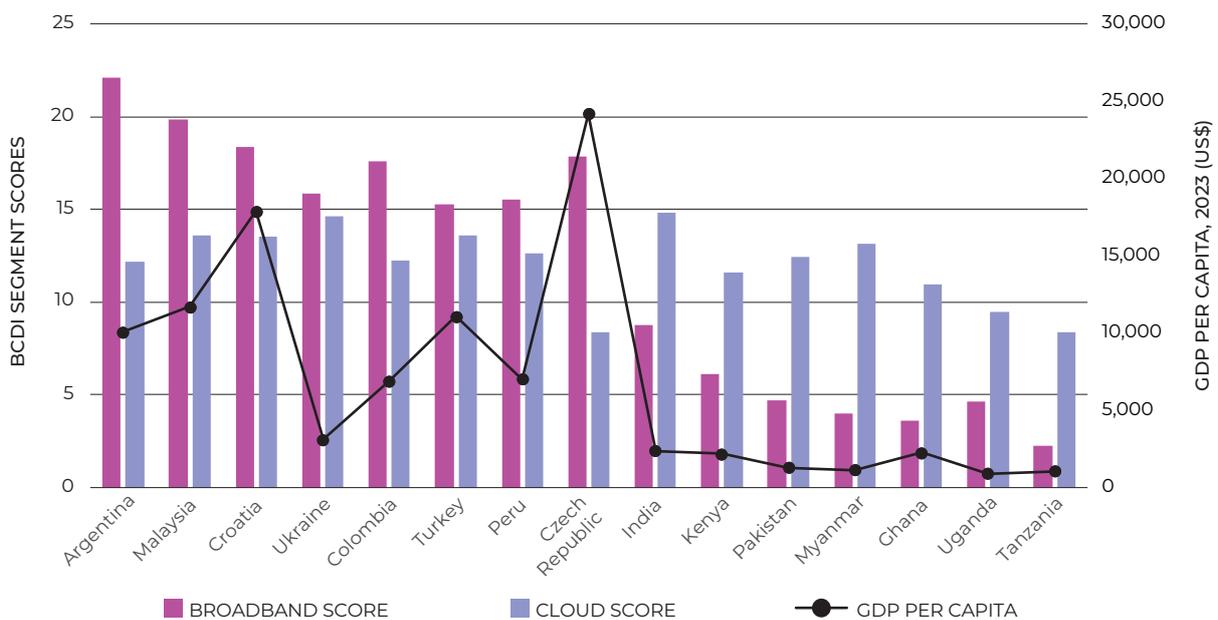
It is also interesting that several countries with relatively low GDP per capita, including Thailand, Mexico, Bulgaria, and Vietnam, are in Cluster 2 owing to the strength of their broadband markets. Like the countries in Cluster 1 with relatively low GDP per capita, this group of countries in Cluster 2 is united by having fiber broadband services available to most households. Vietnam is a particularly striking example, given it combines one of the lowest GDP per capita figures (\$4,053) in the BCDI with one of the highest levels of FTTH coverage at 93%, along with robust household fiber adoption of 66%.

The group of eight countries in the cluster, from Kuwait to Nigeria, have varying GDP per capita but all have relatively low penetration of fiber broadband services. The Philippines and Indonesia are the only countries in this group with double-digit fiber penetration of 22% and 14%, respectively. In this group of countries, the focus should be on developing policies, regulations, investments, and innovation to support the deployment and adoption of advanced fiber broadband services.

CLUSTER 3

The 15 countries in Cluster 3 have below-average scores in both the broadband and cloud segments (Figure 17).

FIGURE 17: BCDI CLUSTER 3 COUNTRIES, SEGMENT SCORES, AND GDP PER CAPITA



SOURCE: WBBA AND S&P GLOBAL INTELLIGENCE (GDP PER CAPITA)

This is understandable because all the countries in the cluster have GDP per capita, which is below the average of all the countries in the BCDI. However, it is useful to understand more about the countries in the cluster to gauge priorities for development.

The two European countries in the cluster, Croatia and the Czech Republic, have relatively high GDP per capita figures. Although most households in each country subscribe to broadband services, they are based mainly on legacy broadband technologies rather than fiber. This limits the end-user experience, which, in turn, hinders the adoption of advanced broadband and cloud services.

The group of eight countries, from India to Tanzania, share common challenges of having relatively low GDP per capita and less-developed broadband networks. However, all these countries show higher scores in the cloud segment. This suggests that despite the limited number of consumers and enterprises with fixed broadband, there is a growing adoption of cloud services. As a result, accelerating the deployment and adoption of broadband services should be a priority in these countries.

There is also a case to be made for the idea that these countries would benefit from skipping the classic path of developing separate advanced broadband and cloud networks and then integrating them and instead moving directly to developing cloud-converged networks. Although the technical feasibility of this approach would need to be proven, the concept of emerging markets skipping traditional systems is well established. For example, the mobile payment service M-Pesa, which launched in 2007 in Kenya when the country had limited traditional banking infrastructure, has become the largest payment platform in Africa. According to M-Pesa, it supports over 70 million transactions per day generated by more than 60 million users across eight countries in Africa. M-Pesa is now a joint venture between Safaricom and Vodacom.

COUNTRY CASE STUDIES AND BEST PRACTICES

This section provides a more detailed analysis of several countries in the BCDI to uncover best practices and other learnings that could benefit broadband and cloud stakeholders worldwide. The case studies cover the US and China from Cluster 1, the UK and Egypt from Cluster 2, and India from Cluster 3.

The following country case studies include analyses of the roles that selected government policies and investments have played in the BCDI scores and rankings, emphasizing the need for governments, policymakers, and regulators to support major industries like broadband and cloud. This support is crucial as it encourages investment, adoption, and usage that drive economic and social benefits.

US

The US ranks first in the BCDI, powered by its leading performance in broadband and a strong showing in the cloud. This result is somewhat surprising because the US has not traditionally led the developments in the global broadband market, particularly fiber deployment. However, the US is the clear global leader in broadband usage and application, powered by its top scores in online video users and views, and its performance in broadband access has improved and is likely to continue to improve, owing to the US government's massive recent investments in the segment. The top ranking for the US also highlights how the broader focus of the BCDI on both broadband and cloud can lead to new insights into the wider benefits of broadband-enabled digitization.

TABLE 4: US, SELECTED STATISTICS

STATISTICS	2023
POPULATION (MILLIONS)	335
GDP PER CAPITA	\$68,781
GDP PER CAPITA RANK IN BCDI	5
FIXED BROADBAND HOUSEHOLD PENETRATION	93%
FTTH HOUSEHOLD PENETRATION	21%
ENTERPRISE AVERAGE SPENDING ON PUBLIC CLOUD (THOUSANDS)	\$1,098

SOURCE: S&P GLOBAL MARKET INTELLIGENCE AND OMDIA

Based on ITU's *How broadband, digitization and ICT regulation impact the global economy* report, the relatively high GDP per capita of \$68,781 in the US means that increasing broadband penetration has a greater positive impact on GDP compared with countries with relatively low GDP per capita. In fact, the ITU found that in the Americas, a 10% increase in fixed broadband penetration leads to a 1.88% increase in GDP.

Like several other countries in the BCDI, the US benefits from high fixed broadband penetration, which stood at 93% of households in 2023. As detailed by the ITU, higher fixed broadband penetration drives more growth in GDP owing to the positive scale and network effects of broadband access.

Although fixed broadband penetration is high, FTTH penetration remains limited, reaching just 21% of households in 2023. Therefore, it is crucial to increase investment in fiber rollouts to drive the next phase of broadband-enabled economic growth in the US.

RANKINGS BY SEGMENT

The abovementioned trends are reflected in the US rankings across the six broadband and cloud segments of the BCDI (**Table 5**). The US ranks number 28 out of the 62 countries in broadband access, with its score constrained by its relatively low coverage and penetration of fiber broadband. The country is ranked tenth in broadband potential, where its performance is supported by a high score for market competition but negatively impacted by its below-average score in broadband affordability. However, it fares much better in broadband usage and application, where it ranks first in the index by a wide margin, largely owing to strong adoption and use of online video services, which in turn drive investment in cloud services.

TABLE 5: US BCDI RANKINGS BY SEGMENT

SEGMENT	RANK
BROADBAND	1
<i>Broadband access</i>	28
<i>Broadband usage and application</i>	1
<i>Broadband potential</i>	10
CLOUD	6
<i>Cloud access infrastructure</i>	3
<i>Cloud usage and application</i>	15
<i>Cloud potential</i>	33
BCDI OVERALL RANK	1

SOURCE: WBBA

In 2023, the average enterprise spending on public cloud in the US exceeded \$1m. This is one of the reasons the US ranks third in cloud access infrastructure. Similarly, US enterprises have relatively high average spending in other cloud segments, including PaaS and SaaS, leading the US to rank number 15 in cloud usage and application. However, the US ranks number 33 in the cloud potential segment as its growth rates for enterprise spending on cloud and storage are lower than in many emerging markets.

US INVESTS \$65BN IN BROADBAND ACCESS TO BRIDGE THE DIGITAL DIVIDE

The US broadband market hit a milestone in November 2021, when the US Congress passed the Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law. The bill allocated \$1.2tn to improve the country's infrastructure and competitiveness, including \$65bn for broadband access. The focus of this funding is to facilitate deployments in unserved and underserved areas. The breakdown of the allocation of the \$65bn funding is as follows:

- Broadband Equity, Access, and Deployment (BEAD) Program (\$42.45bn)
- Affordable Connectivity Fund (\$14.2bn)
- Digital Equity Act (\$2.75bn)
- Tribal Broadband Connectivity Program (\$2bn)
- Additional rural support (\$1bn)
- Middle mile deployment support (\$1bn)
- Private activity bonds for financing rural deployments (\$600m)

The US Federal Communications Commission (FCC) has expressed its preference for full fiber networks to be deployed with BEAD Program funding. The first allocations of the \$42.5bn BEAD funding were announced in July 2023, and up to 20% of funding was released in December 2023.

Although it is too early to gauge the success of the programs, there is no doubt that they represent some of the largest public investments in the US aimed at expanding broadband access in underserved areas to bridge the digital divide. If the programs achieve even a fraction of their objectives, they will accelerate the penetration of fiber broadband across the US over the next four years. That, in turn, is likely to boost the score of the US in the broadband access segment of the BCDI.

Other US broadband policies and programs implemented over the last several years may have impacted current BCDI scores. This includes the FCC's move in July 2022 to raise the national standard for minimum broadband speeds from 25Mbps downstream and 3Mbps upstream to 100Mbps downstream and 20Mbps upstream.

In addition, in December 2021, the US launched the Affordable Connectivity Program (ACP) with a total investment of \$14.2bn. The ACP provided a discount of up to \$30 per month on broadband services for qualified low-income households. The FCC estimates that close to 40% of American households are eligible for the program. The ACP replaced the Emergency Broadband Benefit Program (EBBP) and Emergency Connectivity Fund Program (ECFP). These programs were launched in May 2021 and dedicated over \$10bn in funding to improve affordability and access to broadband services for low-income households, schools, and libraries during the pandemic.

US TURNS REGULATORY ATTENTION TO HYPERSCALERS

The relatively light-touch approach of the US government to regulating the internet may have contributed to the growth of US-based tech giants like Google and Amazon. However, there are clear signs that the US is shifting its approach. The US Department of Justice has recently filed multiple lawsuits against Google, Amazon, Apple, and Facebook's parent company Meta. The lawsuits argue that these companies are harming competition in various ways. This includes an antitrust case against Google that led to a landmark ruling in August, stating that Google had illegally maintained a monopoly in online search.

While online search is clearly a different business from cloud services, it is also true that Google has used the profits of its online search business to fund its expansion into a host of other segments, including cloud services. This raises the question of whether increased scrutiny of tech giants by regulators in the US and other markets could create more opportunities in the cloud services market. Certainly, it is also possible that increasing regulation of the segment could stifle innovation and investment.

Last year, the US Federal Trade Commission (FTC) showed growing interest in the cloud segment by issuing a Request for Information (RFI) on the business practices of cloud computing providers that could impact competition and data security. Managed by the FTC's Office of Technology, Bureau of Competition, and Bureau of Consumer Protection, the RFI requested comment on topics including the following:

- The extent to which particular segments of the economy depend on a small number of cloud service providers (CSPs)
- The ability of cloud customers to negotiate their contracts with cloud providers or are they experiencing take-it-or-leave-it standard contracts
- Incentives providers offer customers to obtain more of their cloud services from a single provider
- The extent to which cloud providers compete based on their ability to provide secure storage for customer data
- The types of products or services cloud providers offer based on, dependent on, or related to artificial intelligence; and the extent to which those products or services are proprietary or provider agnostic
- The extent to which cloud providers identify and notify their customers of security risks related to security design, implementation, or configuration

The FTC received 102 public comments from March to June 2023 in response to the RFI and published them on its website. The FTC's areas of ongoing interest and inquiry include the following:

- Are there signs that the cloud markets are not functioning in a fully competitive manner and that certain business practices are inhibiting competition?
- Are cloud providers sufficiently incentivized by competition to create systems that are sufficiently secure?
- Will competition alone create resilient systems, or is government intervention needed to prevent single points of failure? What policy options are available to improve resiliency and prevent single points of failure?
- How will cloud providers respond to a limited supply of specialized AI chips? How will markets for these chips develop, given their importance in rapidly developing AI markets and the growing demand for specialized AI chips?

In some ways, the growing regulatory attention to hyperscalers and cloud services in the US is a result of the massive success of these companies and the increasing importance of cloud services to the US economy. This can be attributed, at least in part, to the early support provided by the US government to the cloud industry, starting in 2010 when the White House Office of Management and Budget formulated its Cloud First policy. The policy aimed to accelerate cloud adoption by requiring government agencies to evaluate cloud computing solutions as part of any new investment. Then, in February 2011, the US issued its Federal Government Cloud Computing Strategy, which was designed to support the development and adoption of cloud computing across the US government and private enterprises. In the same year, the government committed to invest up to \$20bn to develop cloud applications. The US hit another milestone in September 2018, when it released its Cloud Smart strategy to encourage federal agencies to adopt more intelligent cloud solutions by focusing on three key factors: security, procurement, and personnel.

In addition, the US Department of Defense has supported the adoption of efficient, secure, and flexible cloud platforms in the US military by publishing its Department of Defense Cloud Computing Strategy in July 2012, its Department of Defense Cloud Strategy in February 2019, and its US Offshore Cloud Computing Strategy in June 2021.

CHINA

China, which ranks second overall in the BCDI and number 39 out of the countries in the index in GDP per capita, stands out as the only country in the index to achieve a top ranking despite having a relatively low GDP per capita of \$12,030 (**Table 6**).

TABLE 6: CHINA, SELECTED STATISTICS

STATISTICS	2023
POPULATION (MILLIONS)	1,426
GDP PER CAPITA	\$12,030
GDP PER CAPITA RANK IN BCDI	39
FIXED BROADBAND HOUSEHOLD PENETRATION	99%
FTTH HOUSEHOLD PENETRATION	99%
ENTERPRISE AVERAGE SPENDING ON PUBLIC CLOUD (THOUSANDS)	\$1,488

SOURCE: S&P GLOBAL MARKET INTELLIGENCE AND OMDIA

China's position as one of the world's largest countries and the second-largest economy makes it a special case, but there is no doubt that other countries can learn from the successful government and industry initiatives that have made China a leading broadband and cloud market.

As the statistics in **Table 6** show, China has a highly advanced broadband market. With a fixed broadband household penetration reaching 99% of households, one of the highest in the index, broadband is already contributing significantly to China's GDP.

In addition, China's FTTH household penetration is 99%, also one of the highest in the BCDI. This means that by the end of 2023, close to 600 million households across China's vast territory had access to fiber broadband services with the high speeds and low latencies needed to support advanced applications and services.

RANKINGS BY SEGMENT

China ranks third in broadband in the BCDI and fourth in cloud (**Table 7**). Its second-placed ranking in broadband access is based on its high FTTH household penetration and overall broadband household penetration rates, along with FTTH coverage of 99% of households. That level of FTTH coverage and penetration is notable in a country as large as China and unique in the BCDI among large developing countries.

China also ranks fifth in broadband usage and application, driven by its strong performance in broadband speed metrics, including most households in the country having high-speed broadband connections of 500Mbps or faster. The country ranks number 49 in broadband potential, partly owing to a below-average score in broadband market competition.

TABLE 7: CHINA BCDI RANKINGS BY SEGMENT

SEGMENT	RANK
BROADBAND	3
<i>Broadband access</i>	2
<i>Broadband usage and application</i>	5
<i>Broadband potential</i>	49
CLOUD	4
<i>Cloud access infrastructure</i>	5
<i>Cloud usage and application</i>	3
<i>Cloud potential</i>	45
BCDI OVERALL RANK	2

SOURCE: WBBA

The country ranks fourth in the cloud segment in the BCDI, partly owing to average enterprise spending on the public cloud of \$1.49m and the strong migration of workloads to the public cloud. However, it ranks number 45 in cloud potential owing to relatively low growth rates for enterprise cloud spending.

CHINA'S NATIONAL BROADBAND STRATEGY DRIVES RAPID DEVELOPMENT

China continues to be one of the most ambitious countries when it comes to connectivity targets, especially considering its size and population. The government's major investment in broadband development in recent years has been a key driver of the country's high ranking in the broadband segment in the BCDI.

In January 2022, the country's cabinet unveiled the first five-year plan for the digital economy. As per the plan, the target is to increase the country's gigabit broadband users from 6.4 million in 2020 to 60 million in 2025 and to promote more commercial and large-scale use of 5G.

In March 2021, the Ministry of Industry and Information Technology (MIIT) implemented the Dual Gigabit Network Coordinated Development Action Plan. The plan sets targets for the expansion of gigabit fiber-optic and 5G networks for 2021 and 2023. The goals include covering 400 million households with a fiber network, connecting over 30 million users with gigabit speed, expanding the 5G network beyond the township and village levels, and building over 100 gigabit cities by 2023. MIIT aims to have a total of 3.64 million 5G base stations by 2025.

By November 2021, 100% of administrative villages in China had access to a broadband network. By October 2022, the number of gigabit cities reached 110, about one-third of all prefecture-level cities. As of December 2023, the country reported over 3.38 million 5G base stations and over 1.09

billion fiber-optic ports. Furthermore, in December 2023, the total number of fixed broadband users reached 636 million, reflecting an annual increase of 8%. Among them, fixed broadband users with access to speeds of 100Mbps and above reached 601 million, and those with access to 1Gbps and above speeds reached 163 million. This successful policy explains why China ranks fifth in broadband usage and application in the BCDI, given a relatively high proportion of households in the country have access to high-speed broadband services.

Between 2016 and 2018, MIIT and the National Development and Reform Commission (NDRC) led a three-year action plan for the construction of communications infrastructure, with a budget of ¥1,200bn (\$181bn). The plan aimed to support the development of high-speed fiber optics, the construction of advanced mobile broadband systems, and global network facilities. To execute this plan, the government focused on 92 selected infrastructure projects, with a total investment budget of ¥902.2bn (\$136.3bn).

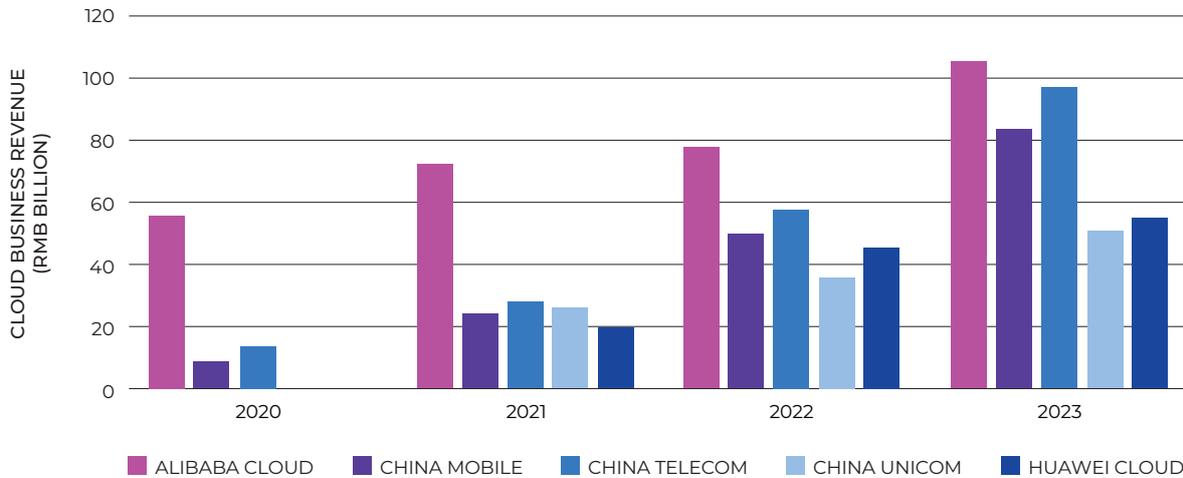
In 2015, the State Council also proposed measures to accelerate high-speed broadband network construction and promote speed upgrades and fee reductions. According to MIIT, from 2016 to 2020, broadband tariffs per unit of bandwidth decreased by more than 95% for consumers and more than 70% for enterprises. The ministry stated that the tariff reductions have benefited over 1 billion users per year, but for service providers, they have meant a cumulative foregone revenue of ¥700bn.

CHINESE TELECOM OPERATORS MOVE INTO THE CLOUD MARKET

The Chinese cloud market is somewhat unique in that it has become a growth engine for the country’s telecommunications service providers. This promotes competition in the market and leads to more options for enterprises evaluating cloud suppliers and services, which should, in turn, lead to increased investment in the segment. Telcos worldwide should also gauge the extent to which the strategies and best practices of major Chinese operators are relevant to their own aspirations to grow in the cloud and other digital markets.

To clarify the extent to which telcos in China have moved into the cloud market, it is worth noting that in 2023, the cloud businesses of three major Chinese telcos achieved higher growth rates compared with Alibaba Cloud, the market leader. The cloud business of China Telecom grew by 68%, while China Mobile’s grew by 66% and China Unicom’s grew by 41%. This growth outpaced Alibaba Cloud, which saw a growth of 36%. In fact, the cloud revenue of China Telecom and China Mobile are now approaching those of Alibaba Cloud (**Figure 18**).

FIGURE 18: CLOUD BUSINESS REVENUE OF CHINESE TELCOS, 2020-23



SOURCE: OMDIA

Chinese telcos have entered the cloud market owing to the slowdown in their traditional connectivity businesses. For example, in 2023, China Telecom experienced a 1% decline in mobile data revenue, while fixed broadband revenue grew by 8%, according to data from MIIT. In contrast, new businesses, including cloud, saw a 19% growth, accounting for 21% of the group's service revenue.

Telcos in China are providing cloud services to consumers and small to medium-sized enterprises through their existing sales channels. They have also established new groups to provide cloud services to large enterprises. These telcos have strong brand recognition in China, allowing them to secure positions as prime contractors or systems integrators for digital transformation projects of large enterprises and local governments.

In addition, the Chinese government started launching initiatives supporting the cloud industry as early as 2015, helping to enable the rise of China's global service providers and the adoption of cloud services by enterprises. This has supported China's fourth-placed ranking in the cloud segment in the BCDI.

For example, in March 2022, the Channel Computing Resources from the East to the West project was launched to further promote the cloud computing industry in China. In July 2022, China Telecom led the launch of the National Cloud to achieve self-reliance, security, and technological leadership in China's digital technology and infrastructure.

UK

The UK is among several European countries in Cluster 2 with above-average scores in broadband and below-average scores in cloud. Its GDP per capita ranks number 20 out of the countries in the index (**Table 8**), so its number 24 ranking in the BCDI is understandable. However, it does suggest that there are opportunities to improve performance and move up the rankings.

TABLE 8: UK, SELECTED STATISTICS

STATISTICS	2023
POPULATION (MILLIONS)	68
GDP PER CAPITA	\$42,827
GDP PER CAPITA RANK IN BCDI	20
FIXED BROADBAND HOUSEHOLD PENETRATION	89%
FTTH HOUSEHOLD PENETRATION	15%
ENTERPRISE AVERAGE SPENDING ON PUBLIC CLOUD (THOUSANDS)	\$850

SOURCE: S&P GLOBAL MARKET INTELLIGENCE AND OMDIA

The UK, like several other Western European countries in Cluster 2, has a relatively high fixed broadband penetration of 89% but a relatively low FTTH penetration of 15%. As mentioned in the previous chapter in the analysis of BCDI country clusters, increasing fiber penetration should be a priority. The UK government is working toward that goal, as detailed below.

However, although there is room for the UK broadband market to develop, it currently has an above-average broadband score in the BCDI and there is even more room for improvement in its below-average cloud score. That makes it interesting to compare the UK's BCDI performance to that of France, a neighboring country with a similar GDP per capita of \$43,120. France, which is in BCDI Cluster 1, has a fiber broadband penetration of 61% and average enterprise spending on a public cloud of \$1.42 million, which is 67% higher than the \$850,000 in the UK. Enterprise average spending on PaaS and SaaS is also significantly higher in France compared with the UK.

While the BCDI is not designed to establish a direct causal relationship between broadband and cloud investment, it is nevertheless noteworthy that France has not only significantly higher

fiber broadband penetration than the UK, but also significantly higher levels of enterprise cloud investment.

RANKINGS BY SEGMENT

The UK ranks number 23 in broadband and 38 in cloud, leading to its overall number 24 ranking in the BCDI (**Table 9**).

TABLE 9: UK BCDI RANKINGS BY SEGMENT

SEGMENT	RANK
BROADBAND	23
<i>Broadband access</i>	31
<i>Broadband usage and application</i>	12
<i>Broadband potential</i>	14
CLOUD	38
<i>Cloud access infrastructure</i>	24
<i>Cloud usage and application</i>	34
<i>Cloud potential</i>	47
BCDI OVERALL RANK	24

SOURCE: WBBA

As suggested above, its broadband score is boosted by its relatively high overall broadband penetration but impacted by its lower penetration of fiber services and consequent lower speeds of broadband services. Its cloud score is dragged down by relatively low levels of public cloud and AI adoption and average enterprise spending on cloud that is lower than in other Western European countries, such as France and Germany.

TARGETING FULL COVERAGE OF FIBER BROADBAND BY 2030

The UK government recognizes the significance of advanced fiber broadband networks. They have set a target to achieve 85% fiber coverage for homes by 2025 and full coverage by 2030. While this represents a downward revision from the previous target of achieving fiber broadband coverage for all UK households by 2025, it shows the country's commitment to accelerating coverage and adoption of fiber services.

In an example of its efforts to overcome barriers to the deployment of fiber networks, in January 2023, UK regulators confirmed amendments to the Building Regulations, making it mandatory for new homes in England to be equipped with gigabit connectivity. Property developers will be legally obligated to include gigabit broadband access during construction. Additionally, a new law, the Telecommunications Infrastructure (Leasehold Property) Act, has been enacted in England and Wales. It aims to facilitate the installation of faster internet connections in apartment buildings when landlords repeatedly ignore access requests from broadband providers. Approximately 2,100 residential buildings should gain access to better broadband connectivity because of this law.

The UK government also launched a £5bn Gigabit Broadband Programme in March 2021, which should speed up the rollout of gigabit broadband to remote and rural areas. The final 15% of premises reached between 2025 and 2030 will be met mostly by the program. In May 2022, the government started inviting contract bids to support fiber broadband rollouts in Cornwall, Norfolk, and Suffolk. The funding should connect 190,000 rural homes and businesses to fiber networks.

UK INVESTIGATES COMPETITION IN DIGITAL MARKETS

The UK's relatively low penetration of fiber broadband services could be one of the key reasons for its relatively low cloud score in the BCDI. However, there are likely many other drivers at play, including the recent slowdown of the UK economy. The level of competition in the cloud and the broader digital market could also play a role, and this is now the subject of regulatory scrutiny in the UK, initially in segments that have the most impact on consumers.

In June 2022, the UK government announced that the Competition and Markets Authority (CMA) would conduct a market investigation into Apple and Google's market power in mobile browsers and Apple's restrictions on cloud gaming through its App Store. It is also taking enforcement action against Google regarding its app store payment practices. The CMA conducted a year-long study of Google and Apple's mobile ecosystems, which was published on June 10, 2022. The study found that Apple and Google have an effective duopoly on mobile ecosystems, which include operating systems, app stores, and web browsers on mobile devices. The CMA has outlined that intervention is required to ensure that both companies do not further restrict competition and limit incentives for innovators.

In April 2023, the UK government introduced the Digital Markets, Competition and Consumers Bill to safeguard consumers and businesses from online exploitation and promote competition in digital markets. The bill grants the CMA the ability to directly enforce consumer law and impose fines of up to 10% of a company's global turnover in case of breaches. Additionally, a new Digital Markets Unit within the CMA will have the power to address the excessive market dominance of tech companies in the country.

EGYPT

Egypt is among the three African countries in Cluster 2, along with South Africa and Nigeria. They all have above-average cloud scores. Egypt ranks number 54 in the BCDI, in line with its number 52 ranking in GDP per capita among BCDI countries and driven by fixed broadband penetration of 40% and FTTH penetration below 1% (**Table 10**).

TABLE 10: EGYPT, SELECTED STATISTICS

STATISTICS	2023
POPULATION (MILLIONS)	113
GDP PER CAPITA	\$3,508
GDP PER CAPITA RANK IN BCDI	52
FIXED BROADBAND HOUSEHOLD PENETRATION	40%
FTTH HOUSEHOLD PENETRATION	0.3%
ENTERPRISE AVERAGE SPENDING ON PUBLIC CLOUD (THOUSANDS)	\$770

SOURCE: S&P GLOBAL MARKET INTELLIGENCE AND OMDIA

Egypt ranks number 54 in broadband access in the BCDI owing to its relatively low fixed broadband and fiber penetration. This also explains the relatively low online video user penetration and views per capita, which leads to the same number 54 ranking in broadband usage and application. The country ranks number 61 in broadband potential, largely owing to its relatively low scores in market competition, incumbent share, and broadband affordability. This places Egypt at number 55 in broadband in the BCDI (see Table 11).

TABLE 11: EGYPT BCDI RANKINGS BY SEGMENT

SEGMENT	RANK
BROADBAND	55
<i>Broadband access</i>	54
<i>Broadband usage and application</i>	54
<i>Broadband potential</i>	61
CLOUD	16
<i>Cloud access infrastructure</i>	20
<i>Cloud usage and application</i>	14
<i>Cloud potential</i>	36
BCDI OVERALL RANK	54

SOURCE: WBBA

Cloud is a different story, however. Egypt ranks number 16 in the BCDI in the segment, driven by its number 14 ranking in cloud usage and application. That is, in turn, owing to enterprise average spending on PaaS and SaaS that is above-average in the BCDI, and a relatively high percentage of workloads in SaaS.

EGYPT INVESTS IN WHOLESALE FIBER, FIXED BROADBAND, AND DIGITAL LITERACY

Egypt has several ambitious public and private initiatives to boost broadband access, fiber broadband deployments, and digital literacy of its citizens. In the fiber market, one of the most notable developments occurred in July 2024, when state-owned Telecom Egypt signed a Memorandum of Understanding (MoU) with the Hungarian telecom group 4iG. The purpose of the MoU is to build, operate, and commercialize FTTH and fiber-to-the-site (FTTS) fiber access infrastructure on a wholesale basis. They will jointly invest \$600m over ten years to provide high-speed internet to approximately six million households. This follows a MoU that Telecom Egypt signed in February 2024 with the Greater Cairo Water Company to expand fiber-optic networks using utility infrastructure.

In addition, the Ministry of Communications and Information Technology (MCIT) stated that earlier investments in infrastructure have significantly improved the quality of broadband services. MCIT says that approximately \$1.6bn was invested in telecom infrastructure from 2019 to 2021 to boost the quality of internet services in the country. This move led to an increase in the average download speed, as measured by Ookla, to 45.67Mbps by December 2020, compared with 6.5Mbps in January 2019. Median fixed broadband download speeds measured by Ookla reached 80Mbps in mid-2024, improving the country's score in the broadband usage and application segment of the BCDI. Meanwhile, in the same period, the government announced plans to replace 95% of the country's copper network with fiber by the end of 2020. The state-owned operator Telecom Egypt said that it had replaced 90% of its copper network with fiber by the end of 2019.

In 2019, the government launched a new plan to improve infrastructure in villages, known as the Decent Life (Hayah Karima) initiative. MCIT's main goals for the project are to deploy fiber broadband to government buildings, hospitals, schools, and households, to improve mobile network coverage and the quality of telecom services in 4,500 villages by establishing cellular base stations, and to promote digital literacy in villages.

The first phase of the three-phase project ran from mid-2021 to 2022 and aimed to expand broadband access and support digital literacy in 1,436 villages with a poverty rate of at least 70%. Phase 2 focuses on developing villages with 50–70% poverty rates, while Phase 3 will cover villages with poverty rates of 50% or less. The MCIT is currently implementing the project's second phase, which includes investments amounting to £E40bn (\$0.84bn) to implement FTTH in selected urban areas.

DIGITAL EGYPT STRATEGY SUPPORTS DIGITAL GOVERNMENT AND INNOVATION

In 2020 the Egyptian government launched its Digital Egypt Strategy. This three-pillar initiative involves improving Egypt's digital infrastructure and the regulatory environment through transformation, capacity building, and innovation. One significant broadband infrastructure development was increasing the number of government buildings connected with fiber from 5,300 between 2020 and 2021 to 35,000 in 2022.

The government's strategy for a digital and sustainable society by 2030 includes several key initiatives, such as digitizing government departments, creating a closed government network linking all government buildings, and supporting the development of the fiber industry. In 2024, the government released its plan to boost fiber-optic cable production by setting up 20 factories, connecting all government buildings by fiber, and establishing the country as a leading regional center for manufacturing fiber cable.

In addition, the Egyptian government invited the US and South Korean companies to invest in ICT projects. It launched the GovTech Innovation Lab, an initiative aimed at empowering startups in the government technology segment to support the development of digital public services. The government says the country's ICT sector saw growth of 16% in the year to June 2023, which could help to explain the relatively high levels of average enterprise spending on cloud services, which drove Egypt's high ranking in the BCDI's cloud segment.

The Digital Egypt Strategy has also led 168 government services to be offered on the country's Digital Platform, and the government says it is investing up to EGP50bn (\$1.05bn) in other digital transformation initiatives, including a project to facilitate seamless data exchange between government agencies.

INDIA

India, the world's largest country based on its population of 1.44 billion, has vast potential in the fixed broadband and cloud markets. However, the country also has significant challenges to overcome to realize that potential. The country ranks number 55 in the BCDI, which is the same as its ranking by GDP per capita of the countries in the index.

Given India's size and stage of economic development, it may not be surprising that it has a relatively low fixed broadband household penetration of 11% and an even lower FTTH penetration of 8% (see **Table 12**).

TABLE 12: INDIA, SELECTED STATISTICS

STATISTICS	2023
POPULATION (MILLIONS)	1,442
GDP PER CAPITA	\$2,388
GDP PER CAPITA RANK IN BCDI	55
FIXED BROADBAND HOUSEHOLD PENETRATION	11%
FTTH HOUSEHOLD PENETRATION	8%
ENTERPRISE AVERAGE SPENDING ON PUBLIC CLOUD (THOUSANDS)	\$419

SOURCE: S&P GLOBAL MARKET INTELLIGENCE AND OMDIA

However, considering the low levels of fixed broadband penetration, it is important to note that India has a much higher level of mobile broadband penetration, reaching 57% by the end of 2023. As detailed in the **Key trends in fixed broadband and cloud development** chapter, the BCDI and this report only focus on fixed broadband. This is because the economic impact of fixed broadband increases as penetration increases, in contrast to mobile broadband, which sees its economic impact decrease as penetration increases.

India ranks number 53 in the BCDI in broadband, driven by its relatively low scores in broadband access and usage and application (**Table 13**). However, it performs better in broadband potential, supported by a high score based on a high level of competition in the fixed broadband market.

TABLE 13: INDIA BCDI RANKINGS BY SEGMENT

SEGMENT	RANK
BROADBAND	53
<i>Broadband access</i>	55
<i>Broadband usage and application</i>	50
<i>Broadband potential</i>	25
CLOUD	36
<i>Cloud access infrastructure</i>	37
<i>Cloud usage and application</i>	32
<i>Cloud potential</i>	26
BCDI OVERALL RANK	55

SOURCE: WBBA

The country has a higher number 36 ranking in cloud in the BCDI, which is understandable given it is a global technology center with a booming market for data centers and cloud services. This explains why India has a relatively high score of 26 in cloud potential, driven by high scores for the growth of public cloud spending and workloads. While India's scores in other cloud segments are constrained by relatively modest levels of enterprise average spending in the country, it has a strong score in AI adoption.

5G SPURS DEPLOYMENT OF FIBER INFRASTRUCTURE, EXPANSION OF FIXED ACCESS

The launch of 5G in India in late 2022 accelerated the demand for fiber infrastructure to provide advanced connectivity for 5G base stations. This has, in turn, extended the reach of fiber networks that can provide services to consumers and businesses. This trend also has government support through a target in the National Broadband Mission. The target aims to have 70% of 5G base stations supported by fiber connections by 2025, up from 38% in 2023.

Operators have also started offering fixed wireless access (FWA) services based on 5G to introduce high-speed broadband services to areas where fiber is not available. For example, in September 2023, Reliance Jio launched JioAirFiber, a 5G FWA service targeting smaller towns and rural areas.

In India, along with many other countries, the government and industry have significantly increased their focus on the fixed broadband market after the COVID-19 pandemic, which led to massive demand for high-speed and quality internet in residential areas. This prompted the Indian government to raise the minimum broadband speeds from 512Kbps to 2Mbps in 2022 and to develop right-of-way standards and policies to enable telcos to speed up the rollout of fiber broadband services across the country.

INDIA SUPPORTS DIGITAL INITIATIVES, DATA CENTERS, AND DATA PROTECTION

The Indian government strongly supports digital initiatives, partly owing to its huge base of IT companies and expertise, which significantly contributes to the country's economy. Examples include Digital India, a program aimed at bringing the government closer to citizens by digitizing government services and making them more accessible by expanding broadband access, and Make in India, an initiative that encourages investment in manufacturing in the country, including in IT and data centers.

In addition, Indian states, including Maharashtra, Andhra Pradesh, Uttar Pradesh, and Telangana, have introduced a range of fiscal and non-fiscal incentives to encourage the development of data centers. These incentives encompass land subsidies, tax or duty exemptions, and the designation of data centers as essential services, among others.

In August 2023, the government passed the Digital Personal Data Protection Act after over five years of discussions. This aligns with other countries' efforts to protect personal data and privacy as digitization accelerates. The Act applies to the processing of digital personal data inside and outside India. Individuals have the right to withdraw their consent to obtain, correct, and erase their information at any time. Entities responsible for collecting, storing, and processing digital personal data must ensure the accuracy of data, maintain security, and erase data upon consent withdrawal or fulfillment of its intended purpose.

WBBA INITIATIVES SUPPORTING THE GLOBAL DEVELOPMENT OF BROADBAND AND CLOUD

Based in part on the BCDI findings, the WBBA has developed several initiatives to support the global development of the broadband and cloud segments.

- **Share resources, expertise, and best practices to promote private and public investments in broadband and cloud networks to bridge the digital divide:** WBBA will share resources, expertise, and best practices with governments, regulators, and industry to promote the construction of broadband and cloud infrastructure worldwide to bridge the digital divide. WBBA will also promote broadband investment and construction by publishing development reports and policy initiatives and advocating for governments to provide policies and funding for universal broadband services.
- **Build a platform for technology innovation to accelerate the broadband and cloud industries' adoption of intelligent, green, and secure systems:** The WBBA is committed to supporting the technological development and innovation of the broadband and cloud industries, particularly through the adoption of intelligent, sustainable, and secure systems. The association delivers on this commitment through its active working groups on broadband strategy and evolution, broadband advocacy, environmental sustainability, network technology, customer premises network, artificial intelligence, and the BCDI. In the future, WBBA will also collaborate with leading universities and research institutions worldwide on research projects to enhance and advance broadband and cloud technologies.
- **Create an open, collaborative, and inclusive industry ecosystem by deepening exchanges and cooperation with relevant industry, national, and international organizations:** WBBA promotes the development of the broadband and cloud industries through open collaborations with relevant industry, national, and international groups worldwide. WBBA actively supports open collaborations by supporting forums, summits, exhibitions, and other services for stakeholders to exchange views and best practices. This is to develop broadband and cloud technologies and promote the industry. As part of this effort, WBBA is committed to providing regular thought leadership based on annual updates to its new BCDI to share best practices and support the development of the global broadband and cloud industries.
- **Support industry standards, product certification, and technology training:** The WBBA plans to support industry standards, provide objective and fair product certification services, and develop innovative technology training. The association will actively seek cooperation with research institutions, universities, and standards organizations to promote the improvement of standards, achieve global broadband and cloud network standardization, integration, and coordination, and cultivate talent and expertise for the development of the industry and society.

These initiatives align with the overall aim of the WBBA, which is to help bridge the digital divide by bringing together industry stakeholders to maximize the social, economic, and environmental benefits of broadband and cloud computing for all. WBBA activities in support of its mission include discussion, promotion, education, and research, including this report detailing the findings of the WBBA's BCDI.

The WBBA's goals include overcoming challenges in industry development, accelerating the healthy and sustainable development of the broadband industry, promoting the comprehensive supply of broadband networks and services, creating new opportunities for industry participants, and benefiting consumers and society. WBBA supports and promotes the interests of stakeholders, including global broadband network operators, suppliers, cloud service providers, governments, financial investors, and vertical industries.

APPENDIX

METHODOLOGY

This report is developed by the World Broadband Association (WBBA) based on research by its member companies, including Omdia. The methodology for the Broadband and Cloud Development Index (BCDI) is detailed in the *BCDI 2024: Overview and methodology* chapter in this report.

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