

HOW NEW TECHNOLOGIES

ARE TRANSFORMING

TELECOMMUNICATIONS

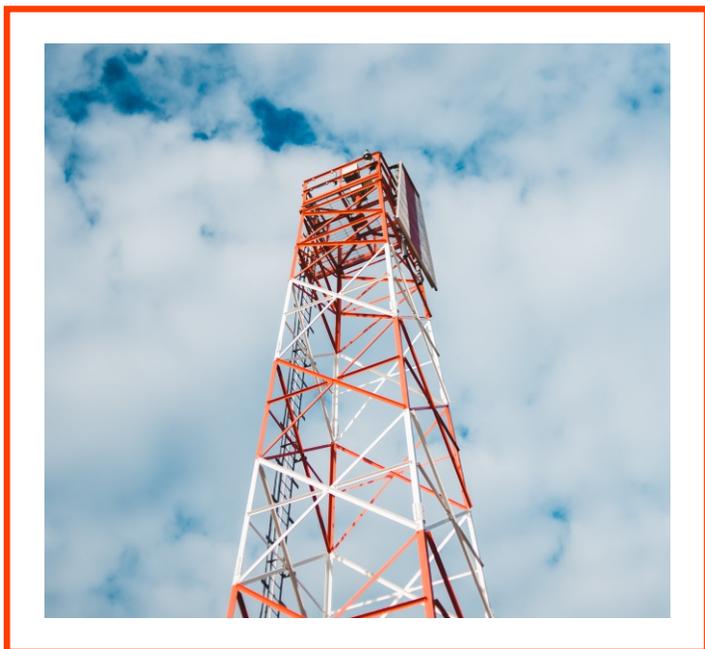
IN LATIN AMERICA AND THE CARIBBEAN

Digital economy



INTRODUCTION

The Latin America and the Caribbean (LAC) region is amidst a digital revolution, and we are convinced that technological innovations hold the potential to accelerate and significantly scale the region's development. These technologies are reshaping both traditional sectors and cutting-edge industries. In this context, the main goal of this report is to present in a structured manner the disruptive technologies that are revolutionizing each of the sectors where IDB Invest operates. The emerging business models will be assessed through the prism of economic and social development, which is a central pillar of the IDB Group. The selection of these models will prioritize inclusion, productivity, and innovation, addressing cross-cutting issues such as environmental sustainability, climate change, and gender equality.



While new technologies offer immense opportunities to boost efficiency and create new value streams, they also represent significant challenges in terms of governance, security, and equality. The rapid adoption of digital solutions has intensified the need to establish a robust regulatory and investment framework to maximize benefits while mitigating risks. Consequently, the role of various economic agents and their ability to embrace and utilize these technological innovations becomes a critical aspect in catalyzing sustainable economic and social development.

As we explore the impact and potential of various key technologies in this report, it is essential to understand that we are not facing an isolated phenomenon, but part of an interconnected ecosystem that evolves in complexity and scale. Advancements in one area, such as Artificial Intelligence or Automation, reinforce and amplify in synergy with others, like Big Data or the Internet of Things, creating a multiplier effect in value generation. This report aims to shed light on how this interconnection of technologies is redrawing the economic and social landscape in LAC, offering an analysis that goes beyond the current situation to project how new technologies will continue to shape the region over the next decade.

CONTEXT

The restriction imposed by the governments of Latin America and the Caribbean (LAC) to control the spread of COVID-19, which included the closure of workplaces, shops, and schools, meant a significant increase in the demand for connectivity throughout the region, namely a growth of 34% between 2019 and 2020¹. This situation, on top of the growing demand for digitization services in all economic sectors prior to the pandemic, has highlighted the role that the telecommunications industry plays in the digital age, by providing the services and infrastructure necessary to enable the overall economy's operation and enable the development of the entire technological ecosystem.

The relevance of telecommunications networks currently creates a great opportunity and, consecutively, an important challenge for the industry, which should confront the need to provide greater capacity, quality, and coverage in services while increasing the pressure to maintain margins after the high investments made in infrastructure. These investments, combined with increasing market competition, are driving many telecommunications operators to implement operational efficiency initiatives, sell assets that were previously considered strategic, enter into partnership models, and channel resources to cope with increasing levels of reinvestment.

¹ Reporte Global de Internet, TeleGeography





In the LAC region, telecommunications networks have expanded their footprint reaching 97% of the population in terms of mobile network coverage in 2021.² Despite the fact that mobile coverage now almost reaches the entire region, 35% of the population (around 230 million people) do not connect to the internet through a mobile device.

To explain the gap between access and use, we took data from the Internet Access and Use in Latin America study by UNDP, which identifies the following barriers to entry as most significant:

1. High cost of service, which could be attributed to the price of data packets, or the low economic income of the segment not connected to the network.

2. Lack of coverage due to poor connection quality since coverage in the region by 2022 reaches 97% of the population.
3. Digital illiteracy associated with the lack of digital skills needed to utilize Internet services.

It is important to note that, according to the same assessment, 20% of offline households did not feel the need or show interest in having Internet, indicating a lack of programs to raise awareness about the benefits of the Internet, especially in rural and low-income neighborhoods.

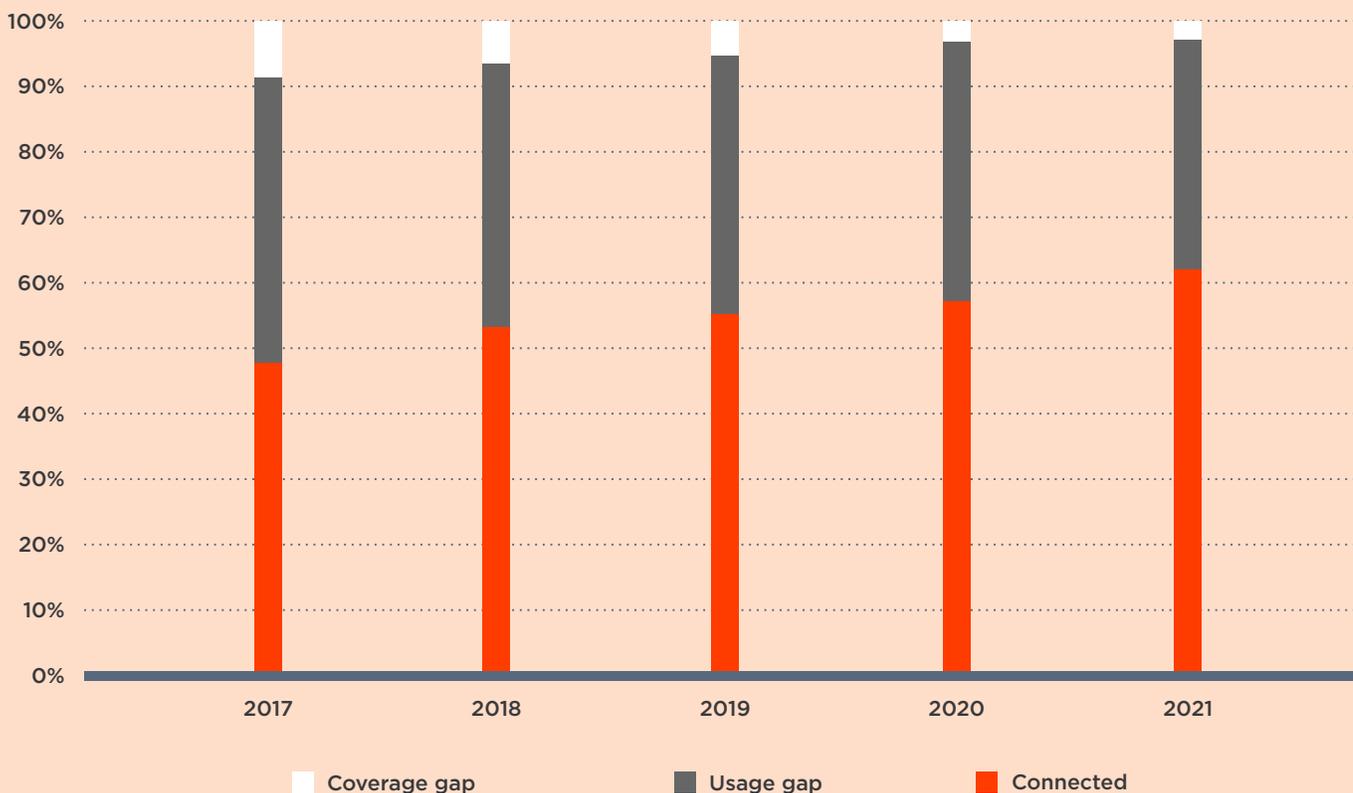
² GSMA - 2022

On the other hand, fixed broadband networks, including fiber optic networks, are mainly concentrated in urban areas, reaching less than 50% of the population in LAC. This prevents access to information for millions of inhabitants in the region, hindering their integration into the educational and professional system and, therefore, Latin America’s social development and competitiveness. In regard to the quality of the connection, it was discovered that rural areas in 2017 had, 34% lower internet quality on average than urban areas. Likewise, in 2019 65% of urban households had access to the internet, compared to 33% of rural households³.

IMPORTANCE OF THE INDUSTRY

As mentioned in the previous section, the telecommunications industry is pivotal both for the social development of LAC and to ensure the competitiveness of industries in the region. On the one hand, digital access favors the inclusion of the population in the educational system and in the professional world. On the other hand, at the corporate level, communications networks are key for the digital transformation of organizations, a fundamental cornerstone for maintaining their competitiveness in the medium and long run. For example, in the Agriculture, Mining,

Evolution of LAC Mobile Coverage



³ GSMA - 2022

and Manufacturing industries, which account for +20% of the region's GDP, the 5G network enables use cases leveraged by new technologies (such as IoT and Big Data), allowing greater traceability and efficiency in operations.

Internet access is directly related to productivity and job creation (650,000 direct and 970,000 indirect jobs were created in 2021) and, as a result, to the growth of economic activity in the region. A 10% increase in broadband connection leads to an increase, on average, of 3.19% in GDP and 2.69% in productivity. While a 10% increase in mobile connection increases GDP by 1.6%. Likewise, we estimate that, by the end of 2022, 40% of the region's GDP will correspond to digital businesses⁴ while, by 2025, the telecommunications industry will represent 7.4% of GDP, equivalent to USD 365 billion.

FORECAST GROWTH

Telecommunications operators are focusing on expanding the adoption of the 4G mobile network, increasing 5G coverage, and continuing to deploy fixed fiber optic networks to maximize their coverage in the region. To this end, it is estimated that, by 2025, 4G technology will be used by 70%, 5G will be used by 11%, and, by 2026, fiber optics will be used by 91% of the population. This expansion will present a significant challenge for the sector, owing to the existing need to improve service efficiency and offer solutions at a lower cost, among other challenges. Likewise, collaboration between governments, regulators, and the private sector will be crucial to encourage the use of these networks among citizens, and in

the attempt to maximize digital inclusion. Therefore, regulatory efforts to encourage competition and free markets are being made.



⁴ IDC 2020

Worldwide, there is a "commoditization" of the industry, bringing about a reduction in marginal profit per user and forcing to rethink the business model of companies in the industry. Besides that, in LAC the trend has been the opposite, countries such as Argentina, Brazil, Chile, Colombia, Ecuador, and Mexico have implemented centralized efforts to implement policies that encourage connectivity which, in the long term, translate into cost reductions for users.

Another important challenge is the assurance of digital security, since, as companies continue to process and monetize the information generated by their users, cybersecurity will be essential to maintain trust in consumers and ensure an appropriate monetization of data generated.

This last point is especially important in a global context that tends to digitize on multiple fronts, from remote work to mass migration to cloud infrastructure of all kinds of public and private organizations.

To ensure that the regional digital divide does not increase, it is important that previous technologies are kept active during the transition to 5G so that they can continue to serve certain areas and segments of the population. In this sense, initiatives such as the one undertaken by Internet Para Todos (IPT) reusing the antiquated and out-of-date 2G network of several operators in Peru, to relaunch it in rural areas under a network as a service model, are very interesting to find a balance between the development of 5G and the exclusion of less favored segments of the digital environment.

In terms of opportunities, the services provided by the industry have proven to be essential for consumers. In a digital world, staying connected has become increasingly important, which is why we expect the industry to become more relevant in people's lives as more applications are incorporated.



THE IMPORTANCE OF TELECOMMUNICATIONS INFRASTRUCTURE:

At NTT DATA, we have spotted the most important advances in terms of infrastructure in the region:

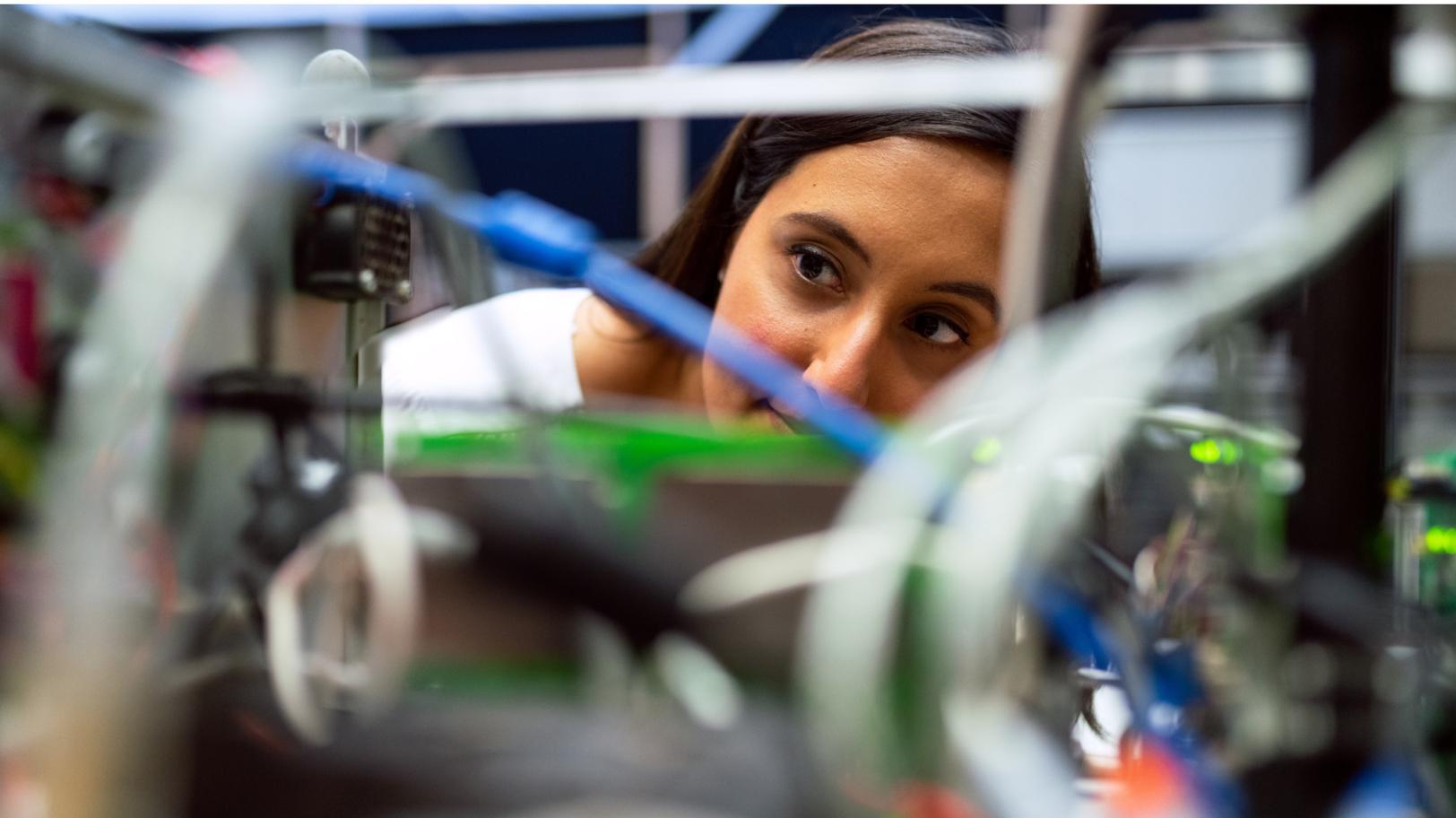
I. Telecommunication Towers

Derived from changes in telecommunications technologies, especially upon the introduction of 5G, the industry is expected to increase its investment in capital. Between the years 2021 to 2025, the industry will invest a total of USD 60 billion, with the majority of that expected to be allocated to 5G implementation.⁵

Moreover, the main mobile operators in the industry are implementing a strategy based on selling passive infrastructure assets, particularly communications towers to finance the deployment of fiber optics and 5G. Specifically, the ownership of towers by mobile operators in 2021 decreased to half of its 2017 level, standing at 25% and making the region one of the lowest proportion of towers.⁶

To enable the mass adoption of 5G, it is necessary to deploy new site formats that complement current macrosites, specifically microsites and nanosites, as well as both indoor and outdoor DAS facilities. These new site formats will need to be connected by optical fiber to be able to withstand the increase in traffic, and it is important that they are installed around major urban centers to ensure their efficiency.

⁵ GSMA - 2022 ⁶ Fitch Ratings



II. Data Centers

There are several factors that are directly impacting the increase of Data Centers in the region. On the one hand, we have regulatory changes in which governments are showing greater concern for the relocation of inhabitants' information and therefore requiring companies to store data within the borders of each country.

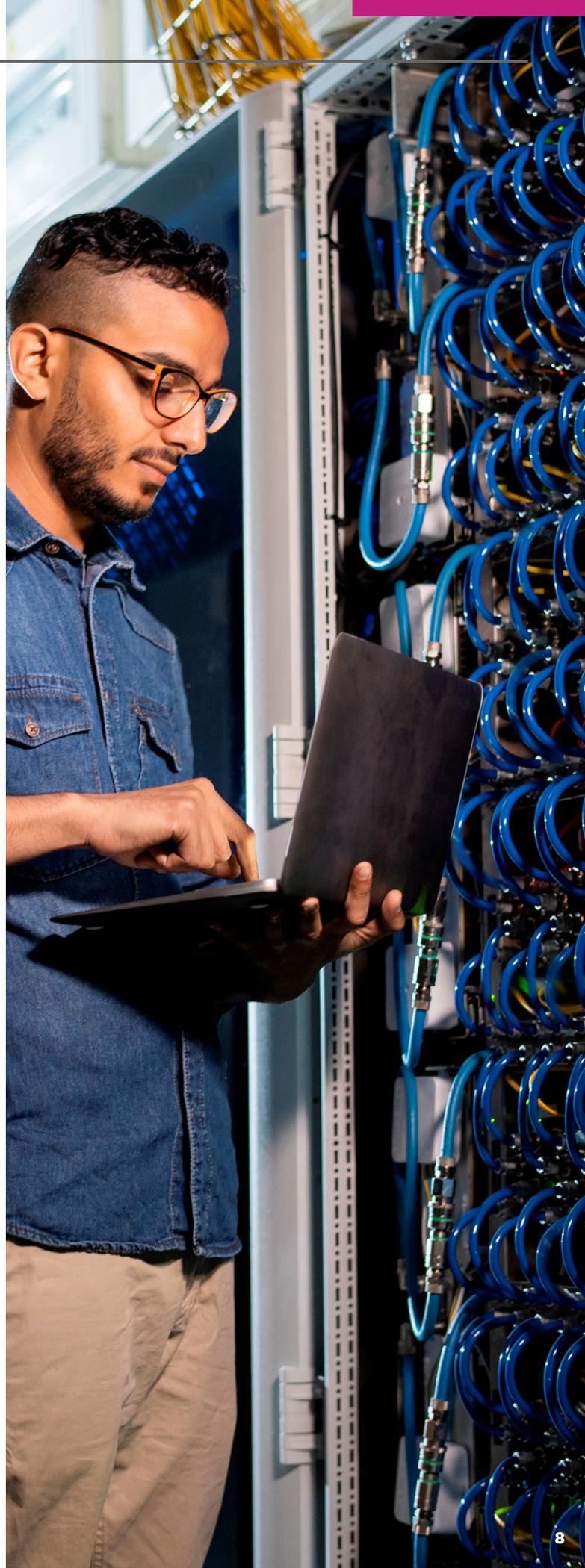
On the other hand, we observe technological advancements, such as increasing digitization and the migration of information to the cloud, which have accelerated especially since the onset of the COVID-19 pandemic.

And, lastly, the needs of individuals and companies within the region, especially hyperscalers, which increasingly require services with lower latency with greater redundancy and resilience.

Data centers are experiencing a strong trend towards decentralization and service concentration, driven by the sale of private data centers, usually in sell and lease back mode, and by the growth of migration to cloud technologies.

Accordingly, it is important to highlight the effect that edge data centers for private networks are having in the region, since they allow for reducing costs and increasing efficiency, bringing infrastructure closer to major urban centers, instead of the traditional model where they travel long distances from central data centers.

These new centers are mainly driven by hyperscalers that have announced plans to build edge data centers in a number of countries, such as Amazon in Brazil, Chile, and Argentina, or Microsoft in Colombia.





Access to relatively affordable power, combined with the supply of skilled labor, lay the foundations for the growth of this type of infrastructure in the region, especially in Brazil, Mexico, Colombia, Chile, and Peru. However, it is important that they improve in efficiency and that they are powered by renewable energies as they currently consume the majority of electricity and water in the industry.⁷

III. Optical Fiber

Fiber optic infrastructure has grown steadily over the last decade, but it has accelerated dramatically in the region in the aftermath of the COVID-19 pandemic. Between 2012 and 2018 44 million connected households were reached while, between 2019 and 2022, this number grew to 100 million.⁸

This increase is explained by the growing need for household's bandwidth and low latency and by the new digital consumption habits derived from mass internet. As a result, it is expected that the trend will continue to increase not only the number of connected households (primarily in major urban areas) but also their demographic reach into more rural regions.

Optical fiber is progressively replacing traditional copper lines, although it is expected that they will continue to coexist in the region in the medium term. The standard that is being imposed is FTTH instead of HFC or Coaxial networks, since these support a higher speed, and are around 10% less expensive.⁹

⁷ Ieee

⁸ Fiber Broadband - Latam Chapter

⁹ Midco



Other explanations for the growth of optical fiber in the region are, in terms of performance: greater data transmission capacity, lower connection outages, and the elimination of interference; in terms of operability: it lowers the cost of operation and maintenance compared to traditional lines, and it has lower exposure to vandalism.

IV. Satellite Internet

The drastic reduction in the cost of launching and building satellites has led to a revolution in the industry, allowing the ingress of new players from the private sector, such as Amazon or SpaceX, and enabling new business models.

The new satellite revolution poses a risk for the Telco sector, as it fosters the ingress of new players offering high-speed services with greater coverage, for example, allowing broadband internet on planes or bringing connectivity to remote places where traditional infrastructure cannot be profitable.

In this sense, seeking alliances between operators to collectively promote LEO satellite systems that complement the existing value offer can be an alternative in the medium term, reducing the initial CAPEX investment required to start the project.

In 2029, LAC's market for satellite connectivity is expected to be the second largest in the world, with an estimated consumption of 1.3 Tbps of information¹⁰. Following this trend, Telesat and Telefónica announced in 2022 the first demonstration of 5G Low Earth Orbit (LEO) satellite backhaul in Brazil and LAC.¹¹

¹⁰ Viasatelite - 2023

¹¹ Bnamericas - 2022

V. Undersea Cables

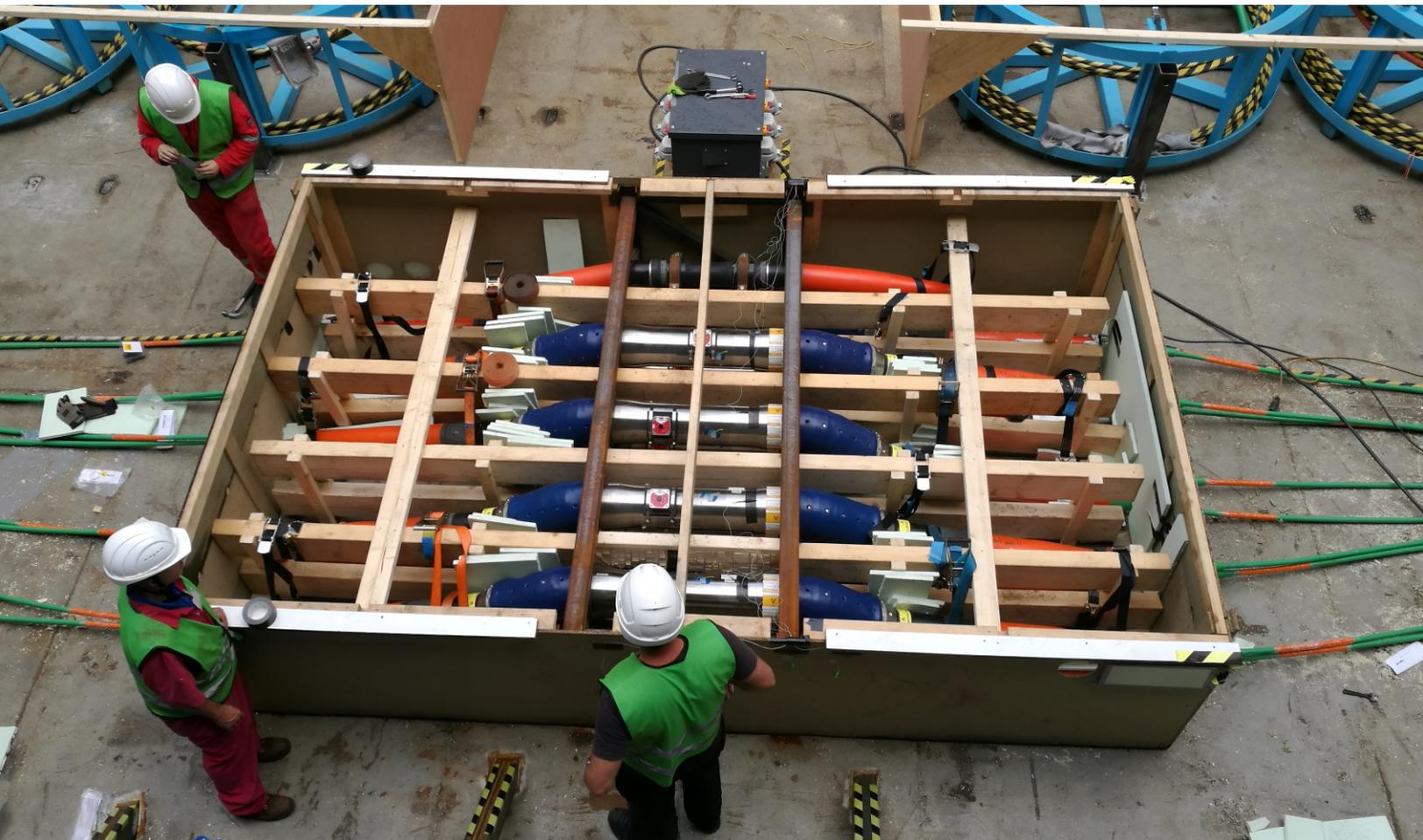
With about 70 undersea cables with about 25% of these nearing the end of their useful life, investments are expected to increase in the coming years, considering above all that another 23 cables are more than 15 years old and are approaching the 25-year end-of-life mark for cables.¹² Gold Data is one of the companies that has announced that it will invest USD 150 million to connect Miami with the cities of Cancun, Queretaro, and Mexico City, installing a capacity of 250Tb/s (25 Tbps per fiber pair).¹³

If we analyze the advancement of hyperscalers, we can see that they are currently involved in building their own cables because the service in the region still does not meet their needs. For example, Google launched the Curie cable in 2019 that connects California with Valparaíso (Chile), and plans to launch Firmina in 2023, which will connect the United States with Brazil, Uruguay, and Argentina, making it the world's longest subsea cable.¹⁴

¹² Bnamericas - 2022

¹³ Golddata

¹⁴ Bloomberg



KEY TRENDS

1. Search for New Revenue Streams

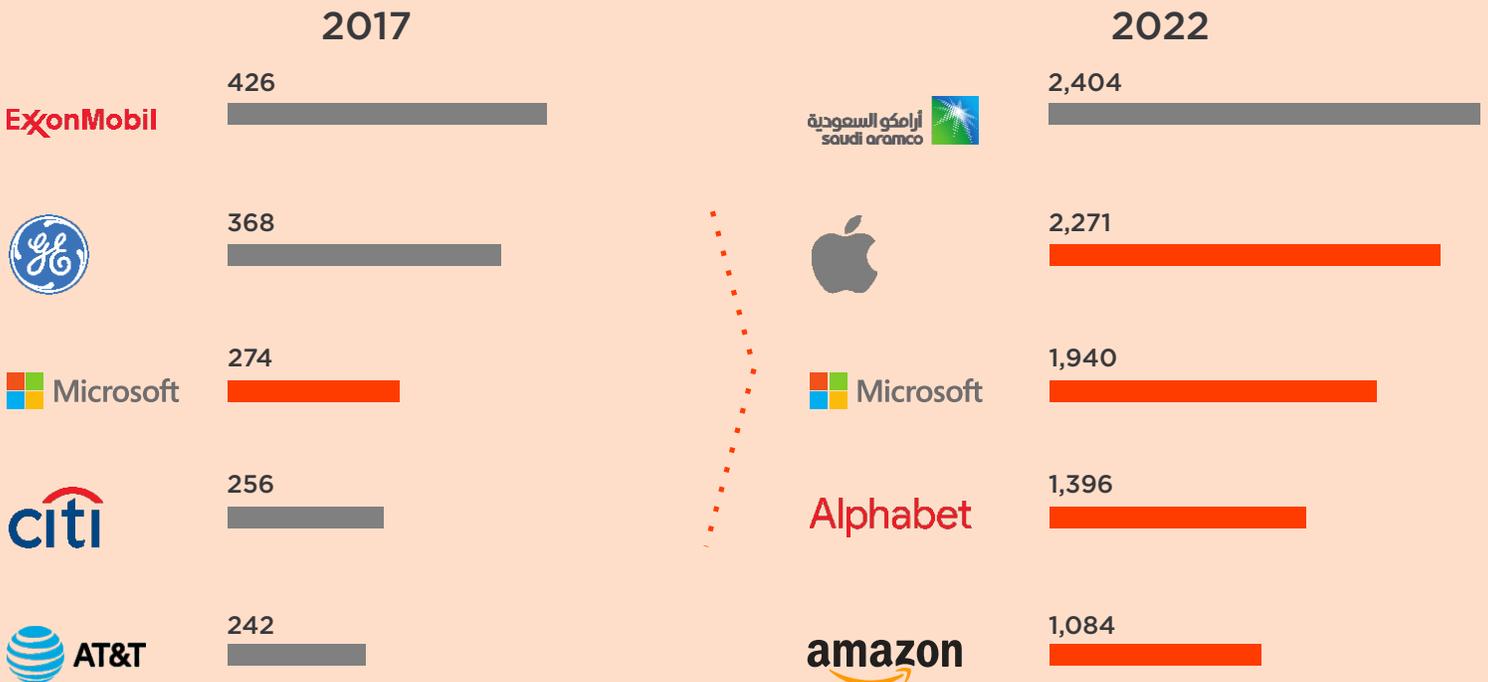
It is ironic that, despite making large investments in CAPEX to install the necessary infrastructure that underpins the digital revolution, large companies in the sector are still not able to capture the value it generates.

Technology giants, which are the main users of communications infrastructure, have experienced unprecedented growth in recent years, while Telecommunications companies have seen competition increase while margins have been shrinking.

This situation calls for a reinvention of the leading players in the industry that intend to monetize connectivity while being an active part of the digital revolution. In this sense, there are several relevant initiatives that are currently being conducted in different geographies:

- Supporting Creation of Ecosystems:** The generation of ecosystems has been accelerated by the digitalization of goods and services stemming from the COVID-19 pandemic and the blurring of barriers to ingress between industries. Among the five companies with the current highest market capitalization, four have

Table 2: Market Cap in USD Billion



an ecosystem-based business model, while the situation was very different 15 years ago.

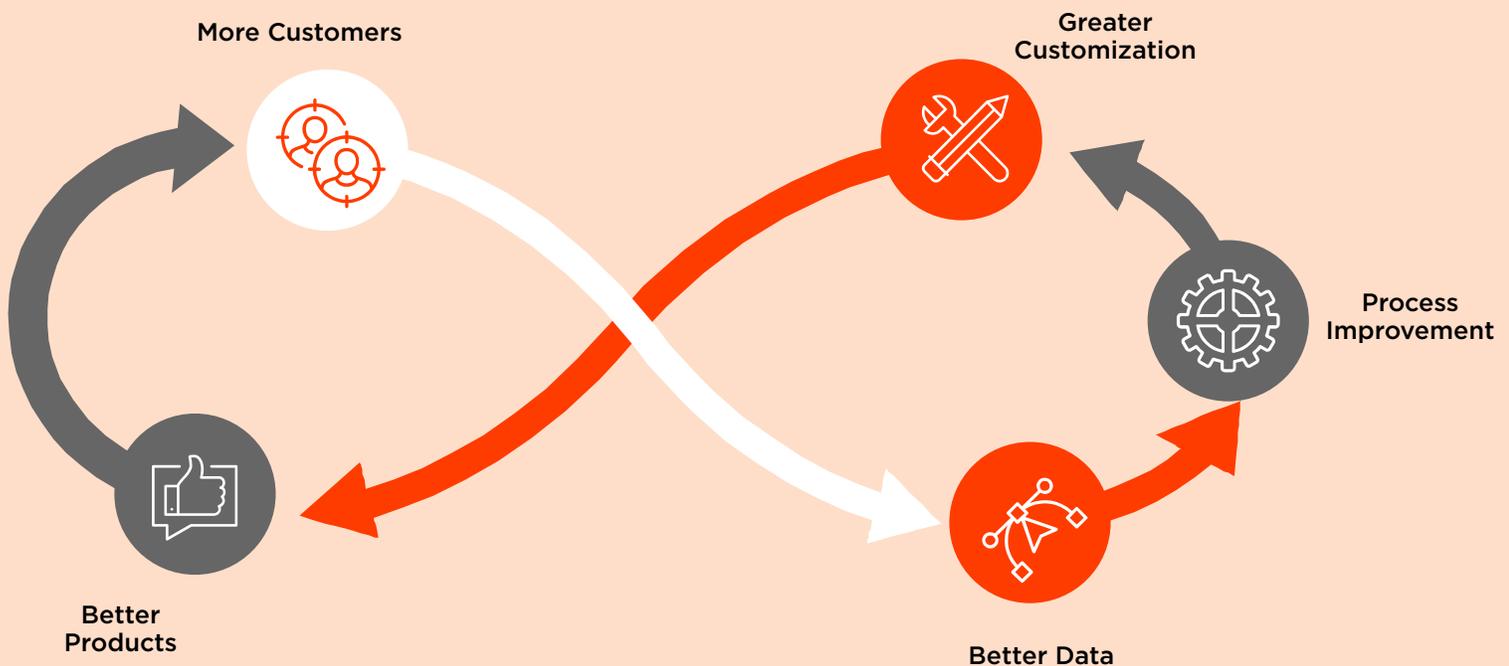
New ecosystems, both digital and hybrid, require the Telco infrastructure to function and develop a virtuous circle based on industry collaboration, with benefits being generated for all parties involved, including end users.

Telcos are attempting to position themselves as an essential axis of these new digital ecosystems, capturing a meaningful portion of the value they generate. For example, new business models centered on electric mobility puts telcos at the heart of the ecosystem coordinating the various actors involved; from power suppliers to manufacturers, charging infrastructure, and sensors inside the vehicle for automated driving.

- **Complementing Product Supply:** The primary assets of Telcos are their large customer base and infrastructure, so the search for revenue streams is usually associated with one of these concepts.

Telcos are attempting to position themselves as an essential axis of these new digital ecosystems, capturing a meaningful portion of the value they generate. For example, new business models centered on electric mobility puts telcos at the heart of the ecosystem coordinating the various actors involved; from power suppliers to manufacturers, charging infrastructure, and sensors inside the vehicle for automated driving.

Table 3: Virtuous Circle of Ecosystems



- **Complementing Product Supply:** The primary assets of Telcos are their large customer base and infrastructure, so the search for revenue streams is usually associated with one of these concepts.

In this sense, the "apification" of the economy enables Telcos to market third-party products to their customers, not only generating a new revenue but also increasing engagement and keeping customers on their platform. Telefónica, for example, launched a pilot in Mexico in 2021 to offer freely available credits to its customers via a partnership with Banco Sabadell, while Vivo launched VivoPay in Brazil that same year, a digital wallet that allows everything from bank transfers to cardless withdrawals at ATMs.

At the same time that traditional connectivity services are slowly transforming into commodities, diversifying the offer of digital goods and services becomes increasingly relevant within a very competitive industry.

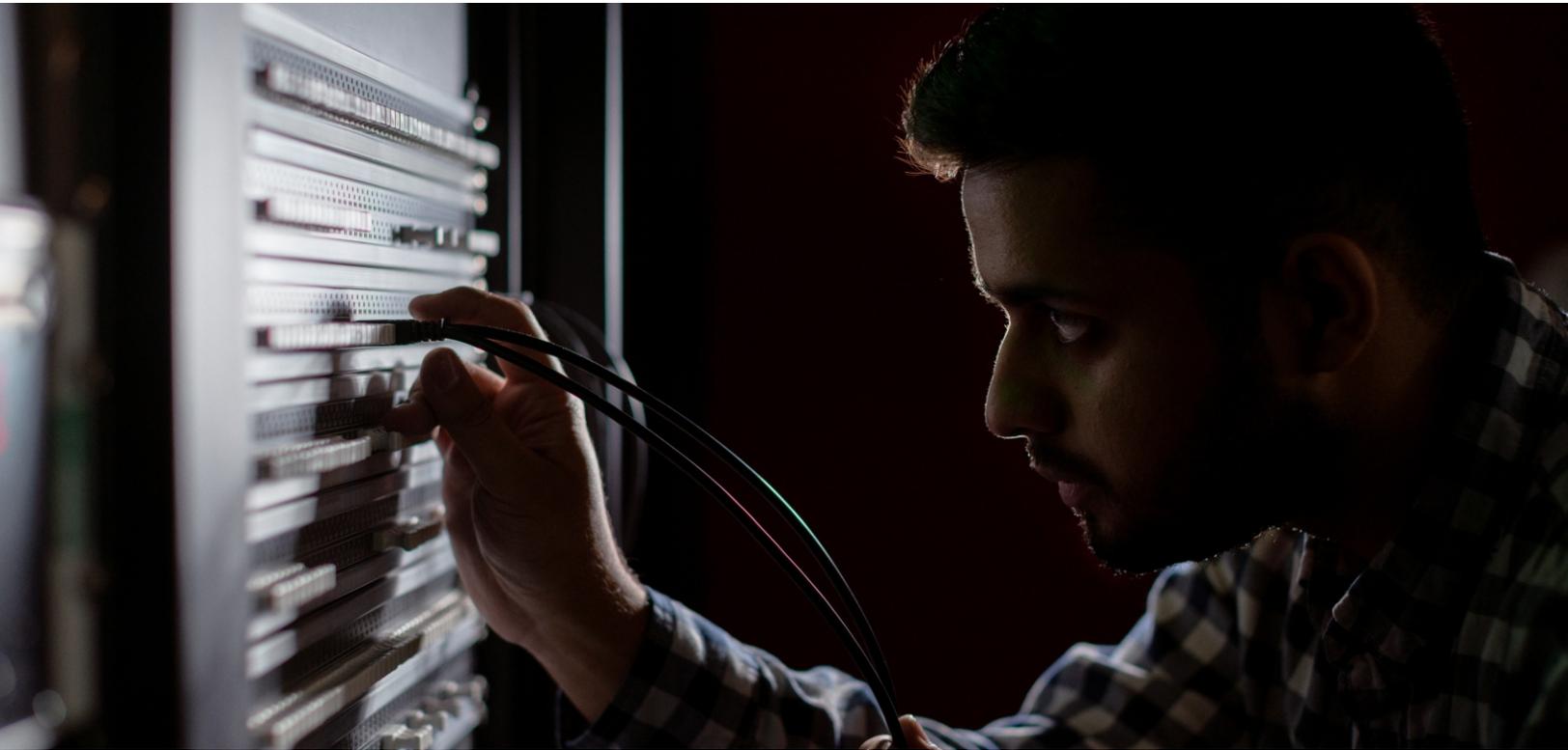
II. Transition to Data-driven Models

The increase in data traffic and the number of devices connected to networks presents an opportunity for Telcos which are now able to collect much larger volumes of information from their customers.

This change in thinking requires structural changes within organizations, beginning with innovative data governance models that place data as a backbone, managing to maximize the value they can generate, both in terms of process optimization and decision-making.

Data traffic through mobile networks will continue to increase over the next decade, as will the availability of higher quality data, providing an





opportunity not only to capture all of the value that these can generate but also to innovate in search of new business models that allow them to be monetized.

III. Offering Services Beyond Infrastructure

Telcos have had to make unprecedented investments in order to provide the connectivity services that are the foundation of the digital revolution. The demand for bandwidth, low latency, and coverage over low-density areas as well as large numbers of connected devices, have been prevalent in recent years and will continue to grow.

Profiting from infrastructure investment is not an easy task, since regulatory pressure and increased competition in the region make it difficult for companies to raise prices and redistribute costs among the different players that use the infrastructure along the value chain.

In this regard, during the Mobile World Congress in 2023, the main global Telcos,

including Telefónica, América Móvil, TIM, Orange, and AT&T operating in LAC, announced the launch of GSMA Open Gateway, an effort that allows developers to create applications and digital solutions directly on the networks through APIs.

With this, they hope to compete not only as an infrastructure provider but also directly with the new digital behemoths.

IV. Consolidation of Professional Infrastructure Providers

The industry is undergoing specialization, where niche infrastructure providers are emerging, including Towercos, Fibercos, Data Center Operators, and cloud services. This trend encourages greater collaboration among infrastructure providers and operators, resulting in significant benefits for the region:

1. Public service quality improvement
2. Capacity building
3. Cost reduction
4. Coverage expansion
5. Investment increase

It is important to remember that, despite the benefits from infrastructure providers entering the region, in order to meet connectivity standards similar to those established by OECD by 2030, annual infrastructure investment should be around 0.4% of the region's GDP, which is a significant challenge.

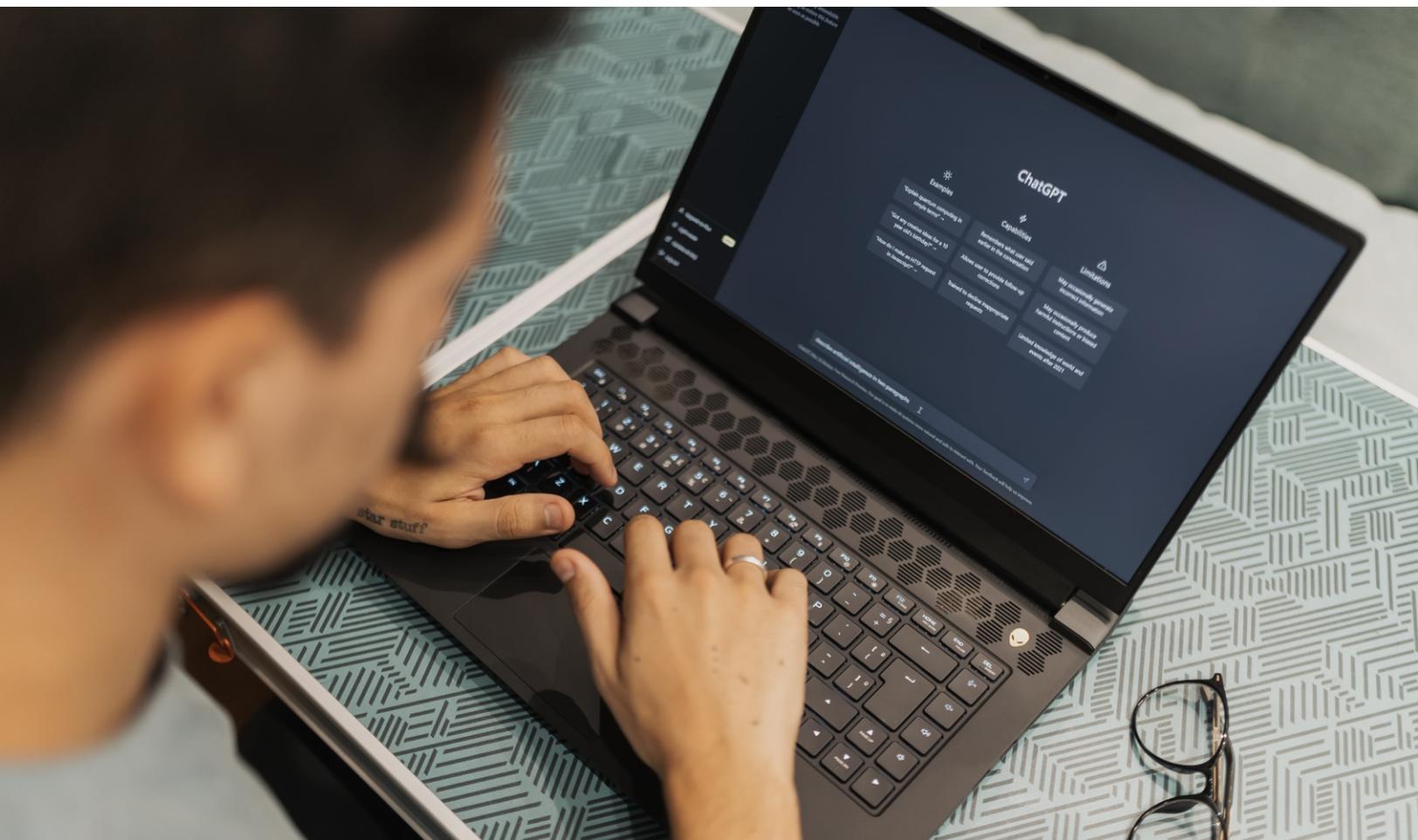
V. The Open Ran Revolution

Historically, operators collaborated with large vendors who provided joint hardware and software solutions, leaving them "tied" to these products because they were not modular. The

current trend is to disaggregate these vendors, which offer white boxes where the software functionality is independent of the hardware, allowing the use of solutions from different vendors in the product.

To ensure interoperability and free competition among the various actors, clear standards must be established in order for this trend to keep growing. The adoption of Open Ran brings with it a series of advantages for operators, ranging from cost reduction as the market becomes more competitive, to increased efficiency, to a lower go to market.





TRANSFORMING THE INDUSTRY THROUGH ARTIFICIAL INTELLIGENCE

AI will have a significant impact on the LAC's telecommunications industry, as it represents a great opportunity to improve the customer experience, reduce operating costs, and create new business opportunities. Between 2020 and 2025, the AI market is expected to grow at a compound annual rate of 46%¹⁵, owing in large part to the increasing use of this technology in the telecommunications industry.

There are currently operators in the region that are introducing AI-based solutions such as Entel and Telcel. The former employs technology to automate the detection and resolution of problems in its telecommunications network, thereby improving its efficiency and lowering operating costs, whereas the latter employs it to improve the personalization of its offers and pricing plans, with a goal of improving customer experience.

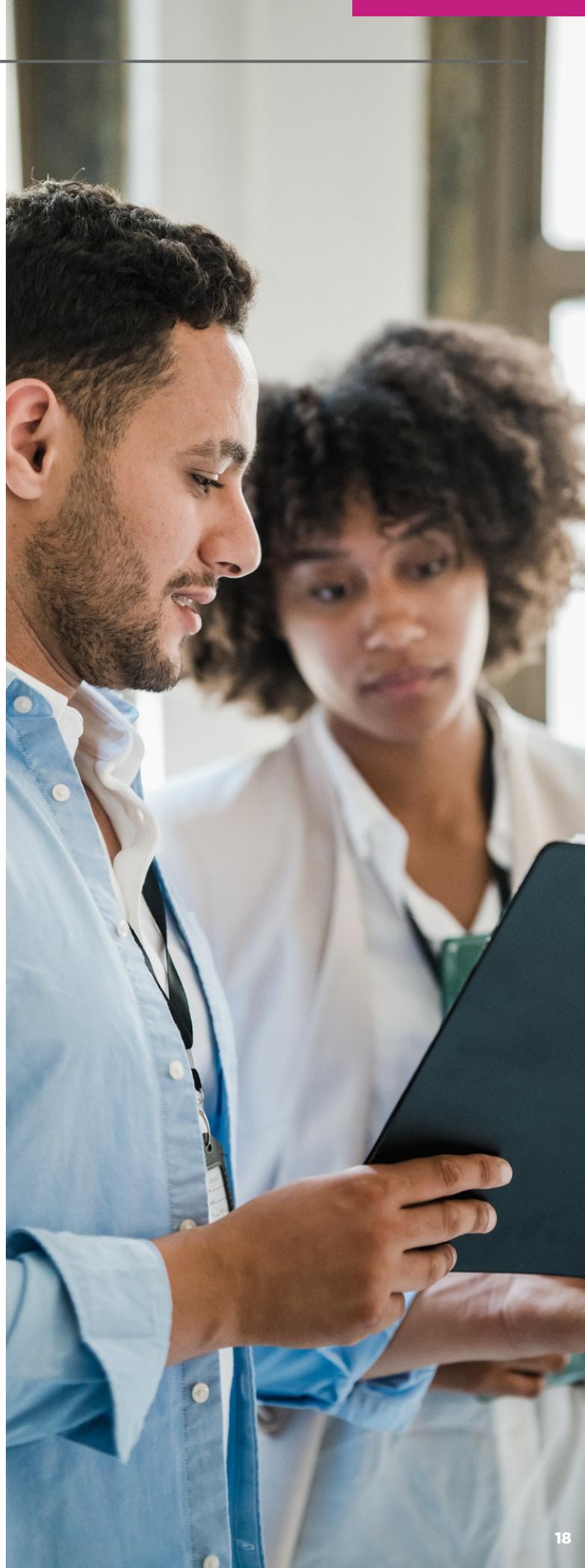
¹⁵ GSMA Intelligence

THE ROLE OF INDUSTRY AS AN ENABLER OF NEW BUSINESS MODELS

At NTT DATA, we see the sector as a critical technological enabler for the new business models that are already emerging and will continue to emerge over the next decade in the region. As a result, the telecommunications industry is approached from a different perspective from the other sectors covered in the report.

Depending on the industry, new telecommunications and connectivity technologies have very different applications. Consider 5G technology as an example; in the Agribusiness industry, Mexican producers are optimizing their crops by monitoring the needs of the crops in real-time, while in Brazil, Rio de Janeiro's government connects cameras throughout the city together with Artificial Intelligence, to increase security at major events such as the carnival.

Following this vision of the industry as a key enabler, the business models that use Telco technology or infrastructure to generate value in the region will be reviewed in detail in the different industries according to their scope of action.



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