Sun, Sea, Sand, and Submarine Cables Systems

The Caribbean region heavily relies on submarine cables for internet connectivity, which are crucial for linking the islands to international internet hubs and managing the region's internet traffic. This dependency is due to several factors, including Geographic Dispersion and Fragmentation, Market Size and Traffic Volumes, and Business Viability (AMS-IX, 2023). Currently, the region's Internet penetration rate stands at 68.4% (Bianchi, 2023), with an average internet speed of 47.95Mbps (Marius, 2023), highlighting the need for enhanced investment in digital infrastructure.

Despite the presence of approximately 30 submarine cable systems in the Caribbean, which include both local, regional, and international systems, the region is confronted with significant challenges. These challenges revolve around the need for Local, Regional, and International Resilience and Diversity and the limited availability of International Systems (AMS-IX, 2023).

To truly improve the digital infrastructure of the Caribbean, it is imperative to make enhanced investments in additional submarine cables and alternative technologies (AMS-IX, 2023). This strategic move will not only boost resiliency but also ensure continuous and reliable internet connectivity for the region. Fostering regional collaborations to share infrastructure costs and benefits are key steps in this direction.

A thriving digital economy depends on all people being able to connect to the internet (GDIP, 2024).

State of the Caribbean Submarine Cable Ecosystem

Propelled by a surging demand for high-speed internet connectivity, telecommunications service, expansion of cloud services, economic growth, technological advancements, redundancy and reliability, and digital transformation activities, the Caribbean islands have emerged as a pivotal player in the global submarine cable ecosystem. This ecosystem, which has witnessed a significant upswing in recent years, is a testament to the Islands' growing importance and the necessity for a comprehensive understanding of its elements.

Understanding the importance of being connected to submarine cable systems is critical. They are a vital part of the region's digital transformation process and its participation in the global digital economy. Without access to submarine cable systems, the region and its islands don't have access to the Internet, with all its consequences.

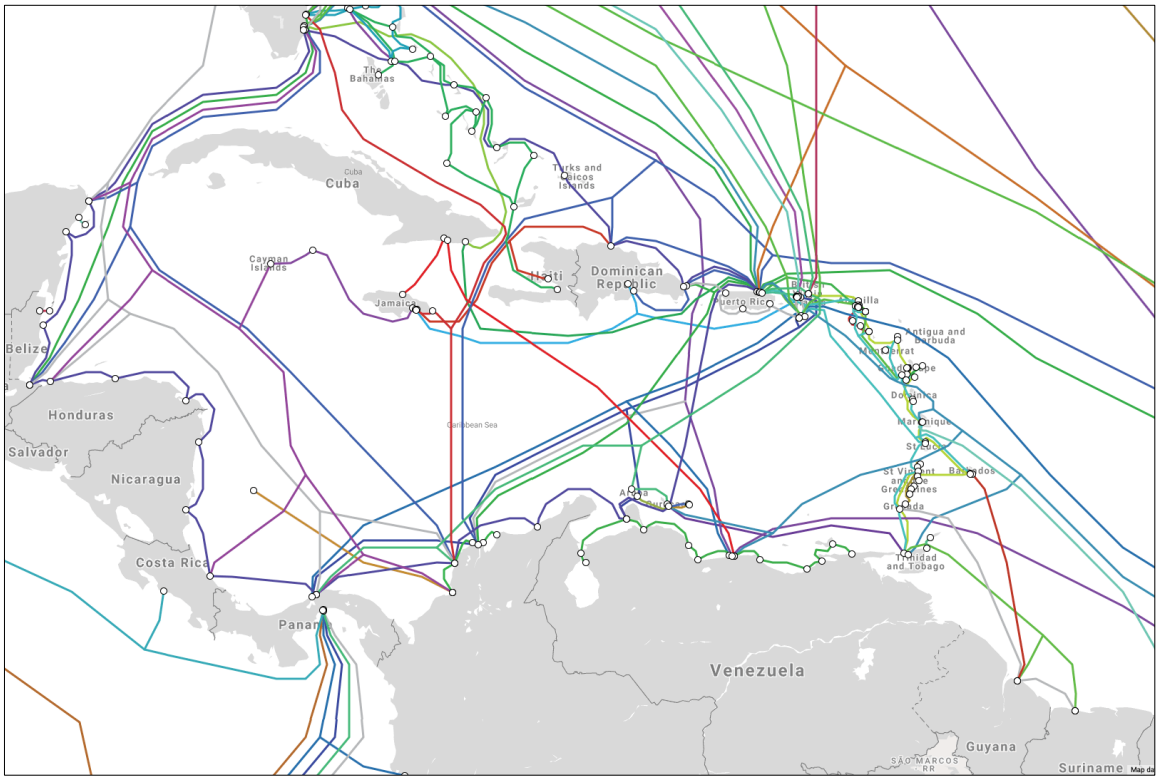

Figure 1: Submarine Cable Systems in the Caribbean: Source TeleGeography

Submarine Cable Systems Ownership

Submarine cable systems are essential for global electronic communications, and their deployment and management often involve consortia and, in some cases, private ownership. For this article, we will focus on consortia. The consortia are collaborative groups formed by multiple stakeholders who share the costs, risks, and benefits of laying and maintaining submarine cable systems. Consortia are multi-stakeholder collaborations consisting of electronic communications companies, content providers, and, at times, governments or other corporations that require vast amounts of international bandwidth. The operating agreement between participating parties provides insight into the governance structure necessary to manage the high costs, technical challenges, and regulatory requirements of laying and maintaining submarine cables. The agreement deals with equity investment and cost of ownership, governance, roles and responsibilities, capacity allocation and usage, regulatory and legal compliance, risk management and insurance, construction, maintenance and upgrades, and lifespan and renewal.

One of the critical issues in the Caribbean is that many essential submarine cables are in the hands of a single market player; this reduces competition. It is necessary to secure a competitive market for off-island connectivity and sufficient geographical redundancy.

Submarine Cable Systems

All submarine cable systems consist of two parts: the wet and dry plants. The wet plant, marked by the beach manholes where the submarine cable enters or exits the water, encompasses the cable, branching units, and amplifier chain. The dry plant, a cable landing station (CLS), is pivotal in housing power management and submarine line terminating equipment and the backhaul referring to the high-capacity circuits that connect the CLS to other terminating points in the same country.
Consortia or private operators typically own the submarine cable systems. In most cases, the cable landing station is owned and operated by the landing party; in the case of a consortium, this would usually be the local operator that is also part of the consortium. Cable Landing Stations, as the name suggests, play a crucial role in the submarine cable ecosystem. They serve as the physical connection point between the fronthaul, and the terrestrial backhaul, vital in connecting the Caribbean islands to the rest of the world. This combination of submarine cables and cable landing stations forms the backbone of the region's electronic communications infrastructure, facilitating the transmission of vast amounts of data, including internet traffic, voice calls, and video streaming.

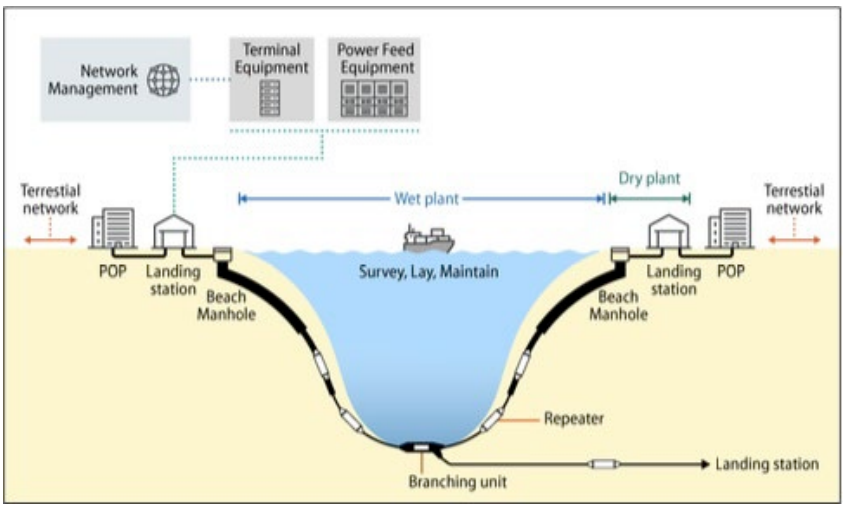

Figure 2: Diagram of a Submarine Cable System *(Gallagher, 2022)*

Submarine cable systems are engineered to achieve an operational life span of 25 years. A submarine cable system may remain operational beyond 25 years. Submarine cable systems are sometimes retired earlier because they become economically obsolete. Once the old submarine cable systems can provide less capacity than newer cable systems at a comparable cost, they become too expensive to keep in service.

Globally, we are interconnected through approximately 213 independent cable systems and 1.4 million km (TeleGeography, 2024) of fiber, and they have quietly become one of the world's most indispensable pieces of infrastructure (Sunak, 2017).

According to Sunak (2017), in a single day, the existing submarine cable systems carry over $10 trillion worth of financial transfers and vast amounts of data, from emails to classified government to government information. If the network disappears, this will severely impact the global economy, underscoring the urgent need to protect and regulate these systems.

One very important issue that the region must deal with is that many key cable systems are no longer consortia cables but single-owner cable systems with vested interests in not only the wholesale submarine cable capacity but also dominance in the local market. A specific issue is very high cross-connect fees in the CLSs or not being allowed to cross-connect dark fiber. Licenses are being forced to buy active capacity from the dominant player. High cross-connect fees are used as an “anti-competitive” tool.

[Questions for government officials, policy makers, or regulators in the regions]

1. How are submarine cable systems in international waters protected against terrorist attacks? (consider attacks on ships in specific geographic locations)
2. Do all consortium partners have equal access to sell capacity in a jurisdiction where it lands if they have the rights to that leg?
3. Do all local licensed carriers have equal access to the capacity provided by the cable system?

The Cable Landing Station

An airport and a cable landing station are critical infrastructure nodes for their respective transportation networks. They serve as hubs, facilitating the flow of people and data across countries, regions, and continents. In essence, airports and cable landing stations are pivotal nodes that enable the movement of people in the case of airports and data in the case of cable landing stations. Here's an analogy to highlight their similarities:

Airport:

- It is a hub for passengers to enter and exit the air transportation network.
- Connects different cities and countries via flights.
- Enforces security checks and customs procedures to regulate the flow of people and goods.
- They are often integrated with other transportation modes like buses, trains, and taxis for onward travel.
- Acts as an economic catalyst by promoting tourism, trade, and commerce.
- Often part of a network of airports providing alternative routes and redundancy.
- Critical for global travel and transportation infrastructure.

Cable Landing Station:

- Functions as a gateway for data to enter and exit the underwater cable network.
- Connects different countries, regions, and continents via submarine cables.
- Implements security measures and regulatory checks to protect and monitor data flow.
- It is often connected to terrestrial fiber-optic networks to distribute data further inland.
- Acts as a digital economy catalyst by enabling internet connectivity, data services, and international communications.
- Part of a global network of cables that provides redundancy and ensures reliable data transmission.
- Critical for global communication and internet infrastructure.

This analogy is important because, as Caribbean islands, tourism has always been and will be an essential part of our economic development, so the operations of our ports were always under the control of a government department, port authority, or other neutral parties, guarantying that all airlines have access to the facilities based on competitive pricing schemes. Over the years, Governments have even granted concessions to private entities to operate our ports. Operators have led the way in providing end-to-end connectivity in the electronic communications industry. In most of our islands, this means that the operator of the consortium landing the cable will take the role of the CLS operator. To operate a CLS in the US, a CLS license is required.

Regulators, as the guardians of fair competition, play a crucial role in ensuring open access to international capacity for all local ISPs. By implementing rules and regulations, policymakers can ensure that access to the submarine cable systems is cost-based and not subject to disproportional charges (Hanafiah, 2008). This is not just about maintaining a fair and competitive local market, but also about ensuring that the benefits of the submarine cable systems are distributed equitably. This means that local operators could buy capacity from any consortium partner if they have availability at the location in question. This underscores the importance of licensing requirements for Cable Landing Stations (CLSs) and the regulatory responsibilities that come with it.

A key component of full liberalization is to encourage the landing of multiple submarine cable systems within a country, enabling licensed operators to access and backhaul their capacity on these submarine cable systems effectively and efficiently for the provision of international electronic communications services, including internet access, which is critical in this era of digital transformation (Hanafiah, 2008).

By building on the previous, regional policymakers and regulatory agencies have the opportunity to enact policies and regulations that foster open access and interconnection with CLS on fair and neutral terms. This strategic move, if implemented, will not only stimulate healthy competition but also significantly reduce

wholesale prices for internet services, thereby benefiting the entire telecommunications industry (GDIP, 2024).

- Encourage open-access cable landing stations CLS and enforce against monopolistic behavior (GDIP, 2024).
- Do not treat private networks as telecom operators (GDIP, 2024).
- Adapt to accommodate new technologies (GDIP, 2024).
- Create and maintain a transparent and stable regulatory framework; if permitting fees exist, ensure they are reasonable and cost-based (GDIP, 2024).

[Questions for government officials, policy makers, or regulators in the regions]

1. Are the CLSs in your jurisdiction independently operated?
2. Is there a licensing requirement for CLS's in your jurisdiction?
3. Is cross-connection at the CLS in your jurisdiction cost-oriented?
4. Do all licensed operates have access to the landing station and bandwidth on the submarine cable systems?
5. Should connectivity to the submarine cable be provided based on dark fiber as opposed to bandwidth based?

Regulating the terrestrial backhaul

Terrestrial-backhaul is a requirement to provide ISPs or other users access to the international capacity provided by the submarine cable system. However, one crucial aspect that often raises questions is the cost of backhaul. Understanding the pricing factors and expenses involved in providing backhaul services is essential for guaranteeing a level playing field in the local market.

The terrestrial-backhaul, a dedicated data connection, is crucial for providing ISPs and other service consumers with symmetrical and uncontended bandwidth. Unlike traditional broadband, shared between users, the terrestrial backhaul ensures consistent performance, high reliability, and fast speeds. This makes it a vital component of the telecommunications industry, underscoring the need for its regulation.

The cost of terrestrial backhaul is influenced by bandwidth requirements, distance and location, service level agreement, installation, and setup. In small markets like ours, terrestrial backhaul costs should be regulated to guarantee a level playing field.

[Questions for government officials, policy makers, or regulators in the regions]

1. Is terrestrial backhaul a regulated service?
2. Are terrestrial backhaul prices cost-oriented?
3. Is purchasing dark fiber an option for licensed operators?

Submarine cable systems serving the Caribbean

Many local, regional, international cable systems, some of which are over 20 years old, are rapidly approaching the end of their lifespans. This imminent retirement, likely by the end of the decade, underscores the urgent need to refresh the cable infrastructure on many routes (Wood, 2024).

Multiple subsea systems, including Americas-II, Maya-1, South American Crossing, Pan-American Crossing, Mid-Atlantic Crossing, GlobeNet (activated in 2000), and ARCOS, South America-1 (activated in 2001), are each unique but share a common trait-they are all approaching the end of their economic lifetimes, necessitating their replacement (Wood, 2024).

Several submarine cable systems have landing stations in the Caribbean, enhancing the region's connectivity. Table 1 provides an overview of all cable systems with one or more CLSs in the Caribbean region. Not all the regional cable systems connect to the Internet; some connect to a neighboring island or group of islands. In the CLS column, "Xs" colored in red identify those cable systems that connect us to the USA and, as such, the Internet through IP transit.

Of the 41 local, regional, or international submarine cable systems that provide connectivity in the Caribbean 16 have reached End-of-Life (EoF) or will reach EoF within the next 5 years. Timely planning and executing a submarine cable system is a complex and lengthy process that can take several years. From the initial concept and feasibility study down to the installation and deployment of the system, it can take up to 4-6 years. Governments must be proactive about cable deployment in the region to ensure the necessary infrastructure is in place to meet future demands. By prioritizing and initiating procurement processes early, governments can entice private and public entities to secure funding to invest in new cable systems well in advance. This foresight helps prevent bottlenecks and ensures a robust and reliable communication network, crucial for economic development and national security.

An island without international connectivity can be likened to an island without an airport. Both situations highlight significant limitations on accessibility, economic development, and the flow of goods, services, and information. Without international connectivity, economic growth is stunted as businesses can't operate efficiently locally, regionally, or in global markets. E-commerce, international trade, and remote work opportunities are all severely hampered.

New Submarine Cables Systems in the Caribbean

There are numerous reasons for the surge in new submarine cable systems worldwide and in the Caribbean region. To illustrate this, let's consider a few influential factors:

1. **Scarcity of potential capacity and fiber pairs**: This refers to the limited availability of space and resources within existing submarine cable systems. The most fundamental driver for new submarine cable systems construction is the limited availability of potential capacity. Demand continues to rise exponentially and could soon lead to capacity exhaustion without new cable investment (Brodsky, 2024).
2. **Ownership economics**: The landscape is shifting as the largest bandwidth users, content providers, are making a significant strategic shift. This is not just a change, it's a seismic shift. As their scale increases on a route, they are moving away from leasing wavelengths or purchasing wavelength IRUs on existing cables. Instead, content providers with substantial demand are now strategically investing in new cables to secure their capacity at cost (Brodsky, 2024) .
3. **Route diversity**: The consumers of submarine cable capacity are not just emphasizing, they are placing paramount importance on bandwidth on multiple cable systems. The establishment of robust mesh networks is not just important, it's critical. It's a game-changer that significantly enhances the level of network availability, a crucial factor in the industry (Brodsky, 2024).
4. **Reducing equipment costs**: As their bandwidth requirements continue to surge, operators are concerned with the cost of adding capacity. However, by building new submarine cable systems with massive capacities, network operators can achieve lower unit costs than lower-capacity legacy submarine cable systems. This cost-effectiveness of new submarine cable systems construction provides a reassuring outlook for the industry's financial viability (Brodsky, 2024).
5. **Replacing aging submarine cable systems**: The need for new cables is also related to the expected retirement of aging submarine cable systems (Brodsky, 2024).

The good news is that there are multiple submarine cable systems in the process of initiating deployment in the region. Early participation is still a viable option. The government needs to take the lead in facilitating the future of connectivity in the region. This will lead to a more robust, reliable, redundant submarine infrastructure. There are that can provide the region with alternative routes to the Internet. By enabling diversity in the investment, the region can also have a more competitive submarine cable ecosystem.

Some of the new submarine cable systems are:

1. Celia: This system is expected to enhance connectivity between the European Union and the Caribbean region. It aims to provide high-capacity bandwidth and increased reliability to meet the growing demand for data transmission.
2. Ella Link: Designed to link the European Union with Latin America, this submarine cable will offer an alternative route, improving redundancy and ensuring uninterrupted service even during maintenance or outages on other lines. It has the capability to connect to the Caribbean region through Cayenne.
3. Nuvem: This initiative focuses on connecting the European Union with the Caribbean, thereby opening new avenues for international business and technological collaboration through faster and more secure data transfer.
4. Trans America Fiber: Aimed at enhancing the digital infrastructure, this system will provide a direct link between the USA and Latin America, significantly reducing latency and improving overall internet speed for users in the region.
5. Bella Programme: This project plans to create a network between the European Union and Latin America and the Caribbean, contributing to a diversified and resilient infrastructure capable of supporting future technological advancements and increasing data traffic.
6. Deep Blue and Deep Blue One
7. Caribbean Express (CX): Caribbean Express will be the only submarine cable system that can offer new dedicated dark fiber pair IRUs in the Caribbean market. The company said that partnerships with local governments may be formed who would leverage the branching units reserved for connections to their respective countries.

All these cable systems are at different levels of development and implementation. By supporting these developments, governments can ensure that the region is well-positioned to take advantage of improved connectivity benefits, such as economic growth, technological innovation, and enhanced global communication.

Conclusion

Having limited access to submarine cable systems (SCS) and cable landing stations (CLS) on an island can have significant implications for digital transformation and economic development.

Digital Transformation

Limited or no access to SCS and CLS can stifle the islands' digital transformation process. Limited or no access to SCS and CLS translates into limited or no access to the Internet. Access to online educational resources, e-learning platforms, and digital classrooms is severely restricted without the Internet. This can hinder the development of digital literacy and skills among the population. Healthcare options, especially in remote areas, are also limited. E-Gov services streamline administrative processes and enhance public service delivery but are hampered. Businesses cannot leverage online platforms to reach broader markets, affecting sales and growth potential. Companies must take advantage of digital marketing opportunities, crucial for reaching customers in the modern economy. The ability to implement flexible working arrangements, including remote work, is significantly reduced. The growth of startups and tech-based businesses is stifled, as they rely heavily on internet connectivity for operations, innovation, and scaling. Collaboration on global research projects and access to scientific data and resources are limited.

Economic Development

Limited or no access to SCS and CLS can stifle the islands' process of digital transformation.
Businesses, the backbone of any economy, will struggle to participate in global trade, reducing export opportunities and foreign exchange earnings. Modern tourists, a significant source of revenue, expect internet connectivity for booking, communication, and sharing experiences. The lack of connectivity can significantly reduce the island's attractiveness as a tourist destination, potentially leading to a loss of revenue that should spur us to take immediate action.

The economy will rely on traditional sectors, reducing opportunities to diversify into technology-driven industries. Access to modern financial services, including online banking and digital payment systems, is restricted, impacting financial inclusion and economic activities.
Investors are less likely to invest in regions with poor connectivity, reducing potential capital inflows for infrastructure and business development. However, with improved connectivity, the potential for capital inflows could increase by [specific amount], facilitating the development of modern infrastructure, including smart grids, IoT, and other connected technologies.

The lack of connectivity not only limits job opportunities in the tech sector and other industries reliant on digital infrastructure, but also restricts access to online training and professional development resources. However, with improved connectivity, the potential for job creation in the tech sector could increase, as outlined on page 24 of the Future of Jobs Report 2023 by the World Economic Forum (WEF, 2023), enhancing the workforce's ability to upskill and adapt to changing economic demands, underlining the urgency of addressing the issue of limited connectivity.

It is essential to realize that digital transformation, support of a regional digital economy, and participation in the global digital economy depend on cloud-based solutions. These solutions rely heavily on high-speed and highly reliable connectivity to data centers hosting them, reinforcing the need for adequate submarine cable infrastructure in the region.

We can conclude that, having access to the Internet is not just a necessity, but a catalyst for digital transformation and economic development on our islands. Overcoming the lack of connectivity can remove significant barriers to progress, unlocking the potential for growth and modernization that is within our reach.

For those of us in the region that do not have a National Submarine Cables Protection and Resilience Framework yet please see the link to the Global Maritime Crime Programme:

- https://www.unodc.org/res/piracy/index_html/GMCP_Submarine_Cables_Handbook.pdf

I want to ask all interested in furthering this subject to check out the CDA website for an environment where we hope that participants will provide the answers to the questions posted in this paper.

References:

AMS-IX. (2023, April). Forum IX BR. Retrieved from Forum IX BR: https://forum.ix.br/files/apresentacao/arquivo/1592/Apresentacao%20Nico%20Scheper.pdf

Bianchi, T. (2023, January). Statista. Retrieved from Statista: https://www.statista.com/statistics/731275/internet-users-caribbean-countries/

Brodsky, P. (2024, May 8). Building Tomorrow's Internet: An Update on New Cable Investment. (P. Brodsky, Producer, & TeleGeography) Retrieved June 2024, from Building Tomorrow's Internet: An Update on New Cable Investment: https://blog.telegeography.com/building-tomorrows-internet-an-update-on-new-cable-investment

Gallagher, J. C. (2022, September 13). Retrieved from https://crsreports.congress.gov/product/pdf/R/R47237

GDIP. (2024, January). Global Digital Inclusion Partnership. Retrieved from Global Digital Inclusion Partnership: https://globaldigitalinclusion.org/2024/01/17/subsea-cables-what-is-at-stake-a-thriving-digital-economy-and-achieving-universal-meaningful-connectivity/#:~:text=GDIP%20recommends%20good%20practices%20for,timely%20repair%20of%20subsea%20cables

Hanafiah, M. (2008). International Sharing: International Gateway Liberalization. Pattaya, Thailand: International Telecommunications Union.

Marius, M. (2023, August 4). ICTPULSE. Retrieved from ICTPULSE: https://ict-pulse.com/2023/08/snapshot-2023-update-of-internet-download-speeds-across-the-caribbean/#:~:text=2023%20test%20results%20for%20the%20Caribbean%20region&text=Across%20the%20region%2C%20the%20average%20download%20speed%20was%2047.95%20Mbps.&text

Sunak, R. (2017). Undersea Cables. London: Ploicy Exchange.

TeleGeography. (2024, June). TeleGeography. Retrieved from TeleGeography: https://www2.telegeography.com/submarine-cable-faqs-frequently-asked-questions#:~:text=How%20many%20kilometers%20of%20cable,submarine%20cables%20in%20service%20globally

WEF. (2023, May). weforum. (WEF) Retrieved July 2024, from weforum: https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf

Wood, P. (2024, April 3). The Reality of Latin American Connectivity. Retrieved June 2024, from Telegeoraphy: https://blog.telegeography.com/the-reality-of-latin-american-connectivity