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Beneath the Waves: Addressing Vulnerabilities in Africa's Undersea Digital Infrastructure

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Introduction

Undersea cables, commonly known as submarine cables, play a crucial role in Africa's digital infrastructure. These cables serve as the fundamental infrastructure of the global internet, transmitting over 99 percent of the world's data traffic across oceans and continents.[1] In the early 2000s, fiber optic submarine cables arrived on the African continent, linking African countries to global telecommunications networks and heralding a transformative era for internet connectivity across the region.[2] These cables have revolutionized internet access and affordability, significantly boosting connectivity across the continent and cultivating a vibrant, technology driven ecosystem that ignites innovation.[3] Today, there are seventy-seven cable networks connecting Africa to the global telecommunications network, and new cables continue to be announced.[4]

Despite these gains, new challenges—specifically undersea cable cuts—have arisen, resulting in internet disruptions across many African countries. The most severe outage occurred in March 2024, when ten African countries, mostly in West and Southern Africa, lost connection to the internet because of disruptions in four undersea cables: the West Africa Cable System (WACS), the Africa Coast to Europe (ACE), MainOne, and the South Atlantic Telecommunications cable number 3 (SAT3).[5] A few months later, an outage was reported in East African countries after cuts were reported in the Eastern Africa Submarine Cable System (EASSy) and the Seacom cable.[6] These incidents demonstrated the vulnerability and fragility of Africa's internet infrastructure and underscored the need for a robust and resilient agenda for this foundational digital infrastructure.[7]

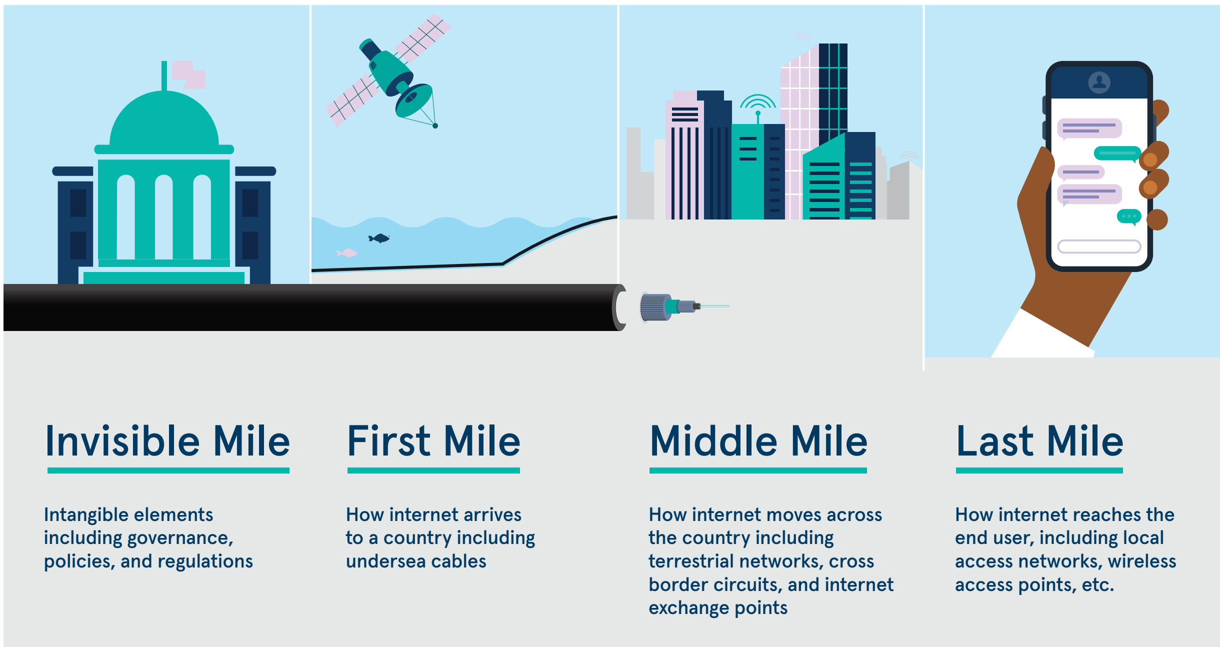
This paper recommends two strategies to enhance the resilience of Africa's network of undersea cables: implementing redundancy measures and establishing a new harmonized governance approach at both the national level and regional level. The paper asserts that the resilience of undersea cables can only be achieved through collaboration and cooperation among various stakeholders, including in the private and public sectors.

The Importance of Undersea Cables to Africa's Digital Connectivity

The African continent has identified technology as essential for digital transformation and a tool to unlock new pathways for economic growth, innovation, and job creation. In the African Union's Digital Transformation Strategy, the continent's leaders lay out a vision and road map for harnessing technology and innovation to meet Africa's development goals.[8] The document calls for ubiquitous connectivity for all Africans, noting the significant role of submarine cables. The Continental Artificial Intelligence Strategy sets an agenda for artificial intelligence (AI) to bring socioeconomic change to African people.[9] Similarly, at the national level, many African countries have developed national strategies and policies that identify digital technology as a tool for socioeconomic growth.[10] For these goals to be achieved, innovators, business leaders, students, and all others in Africa need access to the affordable and reliable internet that undersea cables can provide.

Undersea cables constitute a critical component of the internet delivery chain, serving as an integral part of the first mile infrastructure that facilitates internet access to a country (see figure 1). They connect and transmit data to the middle mile—terrestrial networks, such as national backbones. These subsequently link to the last mile, facilitating connections to the end user via mobile or fixed broadband services. The significance of undersea cables to Africa, therefore, cannot be underestimated and necessitates strong governance (considered part of the invisible mile) and management to guarantee that Africa's internet ecosystem flourishes and delivers the anticipated digital benefits.[11]

Figure 1. Undersea Cables and the Internet Delivery Chain



Source: "Kenya Digital Economy Assessment," World Bank Group, 2019, https://thedocs.worldbank.org/en/doc/345341601590631958-0090022020/original/DE4AKenyasummarypaperfinal.pdf.

Africa's Undersea Cable Landscape

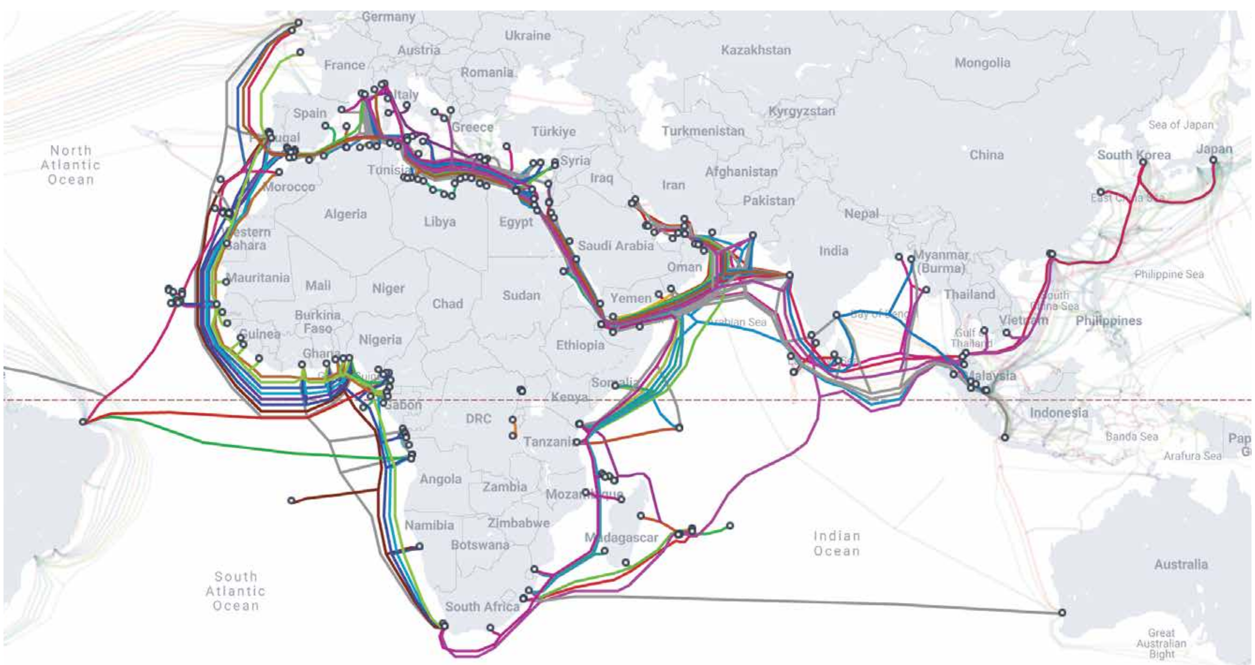
There are an estimated 600 undersea cables globally, with seventy-seven of them landing on the African continent (see figure 2).[12] Cables landing in Africa are dispersed across thirty-seven of the continent's thirty-eight coastal countries; Eritrea is the exception.[13] Egypt, South Africa, Djibouti, Nigeria, and Kenya have the most cable landings and are regarded as regional hubs (see figure 3). Undersea cables not only benefit Africa's coastal countries but also connect landlocked countries through terrestrial cross-border connections. For example, Kenya has cross-border links to neighboring Ethiopia, Somalia, South Sudan, Tanzania, and Uganda.[14]

Cables landing in Africa typically observe three routes: a West African route that connects to Europe via the Atlantic Ocean, an East African route that connects to Asia via the Indian Ocean, and a North African route that connects countries stretching from Djibouti to Morocco.[15] The North African route heralded the arrival of undersea cables to the continent with the landing of the Southeast Asia–Middle East–Western Europe 3 (SEA-ME-WE 3) cable in 2000.[16] SEA-ME-WE 3 (now retired) connected Egypt and Djibouti to global telecommunications networks.[17] However, it was not until the landing of the

South Atlantic 3/West Africa Submarine Cable/South Africa Far East (SAT-3/WASC/SAFE) cable in 2001 that high-speed internet connectivity reached sub-Saharan Africa. SAT-3/WASC/SAFE connected South Africa to Europe, establishing the West African route. The East African route was initiated with SEACOM's arrival in 2005, followed by the East African Marine System (TEAMS) and Lower Indian Ocean Network (LION) in 2010 and EASSy in the same year.[18] In 2023, Africa's routing underwent a significant transformation with the introduction of the 2Africa Cable, which encircles the continent.[19]

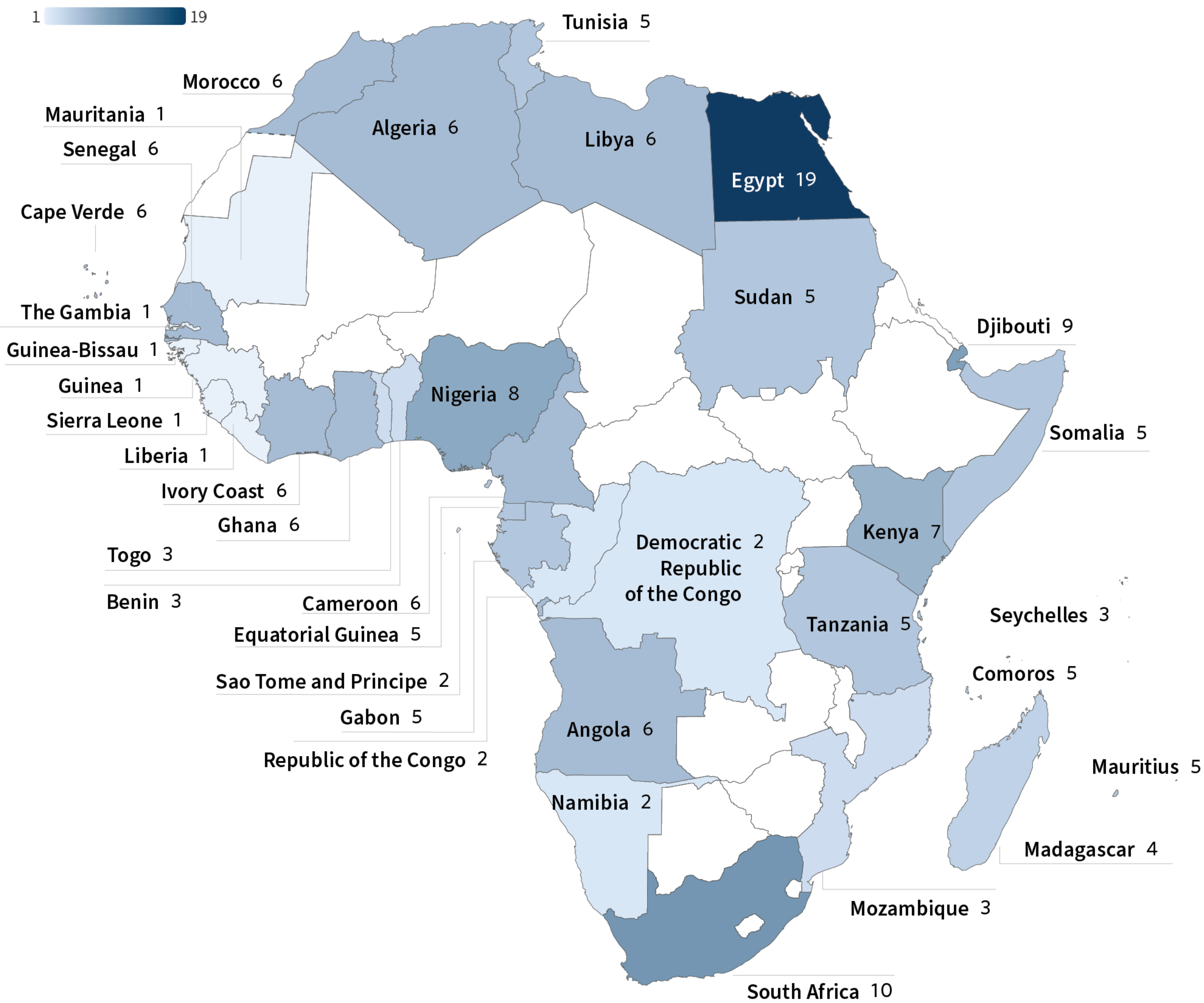
New undersea cables continue to land in Africa.[20] In 2024, new cables were announced, such as Umoja, which will be the first undersea cable to connect Africa directly to Australia, and the Indonesian Cable Express IV.[21]

Figure 2. Undersea Cables Connected to Africa (2025)



Source: Submarine Cable Map, https://www.submarinecablemap.com.

Figure 3. Number of Undersea Cable Landings in Africa (Per Country in 2024)



Source: Author's compilation using data from Submarine Cable Map, https://www.submarinecablemap.com.

The ownership of these cables varies, encompassing both public and private sector entities. A majority of cable projects are carried out by a consortium, typically formed by parties interested in utilizing the cable.[22] For instance, the 2Africa cable consortium includes eight partners: Bayobab (formerly MTN GlobalConnect), Center3, China Mobile International, Meta, Orange, Saudi Telecom Group, Telecom Egypt, Vodafone, and West Indian Ocean Cable Company. Earlier cable projects in Africa, such as EASSy, received support from governments and multilateral organizations.[23] Over the past ten years, there has been a notable transition from investments made by African telecommunications companies and governments to those by major international technology firms. The African coast has witnessed the arrival of privately owned undersea cables from Meta, Facebook, Google, and Amazon, signaling a rise in U.S. investments in Africa's digital economy.[24]

The proliferation of new undersea cables is driven by various factors, including the continent's burgeoning digital economy, which is increasing demand for secure, affordable, and fast internet. Already, Africa's undersea cables have increased internet access and internet speeds. Google anticipates that the Equiano cable will enhance internet speeds in Nigeria, South Africa, and Namibia while also lowering internet costs in these countries. The company reported that the cable could increase Nigeria's and South Africa's internet penetration rates by 7 percentage points and Namibia's by 9 percentage points between 2021 and 2025. Furthermore, it projected the cable will generate 1.6 million jobs in Nigeria, 180,000 in South Africa, and 21,000 in Namibia.[25] Other studies show that higher internet penetration rates resulting from undersea cables can increase GDP growth, productivity, and employment.[26]

The proliferation of faster and cheaper internet, in turn, has propelled the growth of Africa's technology innovation hubs. Innovation hubs are cocreation spaces that provide startups with the resources to ideate, build, and scale solutions. Research shows that there are over 1,000 technology hubs in the continent helping drive economic growth, including Kenya's iHub and Nigeria's CcHUB.[27]

A New Threat to Africa's Digital Transformation: Undersea Cable Disruptions

A new challenge—cable cuts—is threatening the gains from undersea cables. Cable cuts can cause prolonged internet outages, as was evidenced in West and Southern Africa in March 2024 and in East Africa in May 2024.[28] These cuts have profound social and economic effects because the majority of Africa's connectivity—encompassing everything from e-government services to video conferencing and sending emails—is routed through these cables. In 2024, cable cuts in West Africa cost Nigeria over $590 million in four days.[29] The repair of one cable is estimated at $2 million; the 2024 West African outage involved four cables, leading to an estimated cost of $8 million.[30]

Undersea cables are vulnerable to the following main threats:

- **Natural disasters:** Seismic activities can lead to cuts in undersea cables. The West African outage of March 2024 was attributed to seismic activity, and in 2023, an undersea landslide caused outages in SAT-3 and the WACS.[31]

- **Human accidents:** The most common cause of damage to undersea cables is accidental, often from commercial fishing and shipping activities.[32] Studies indicate that of the approximately 150–200 annual cable faults recorded globally, 70–80 percent were caused by accidental damage, primarily from fishing activities and vessel anchoring.[33]

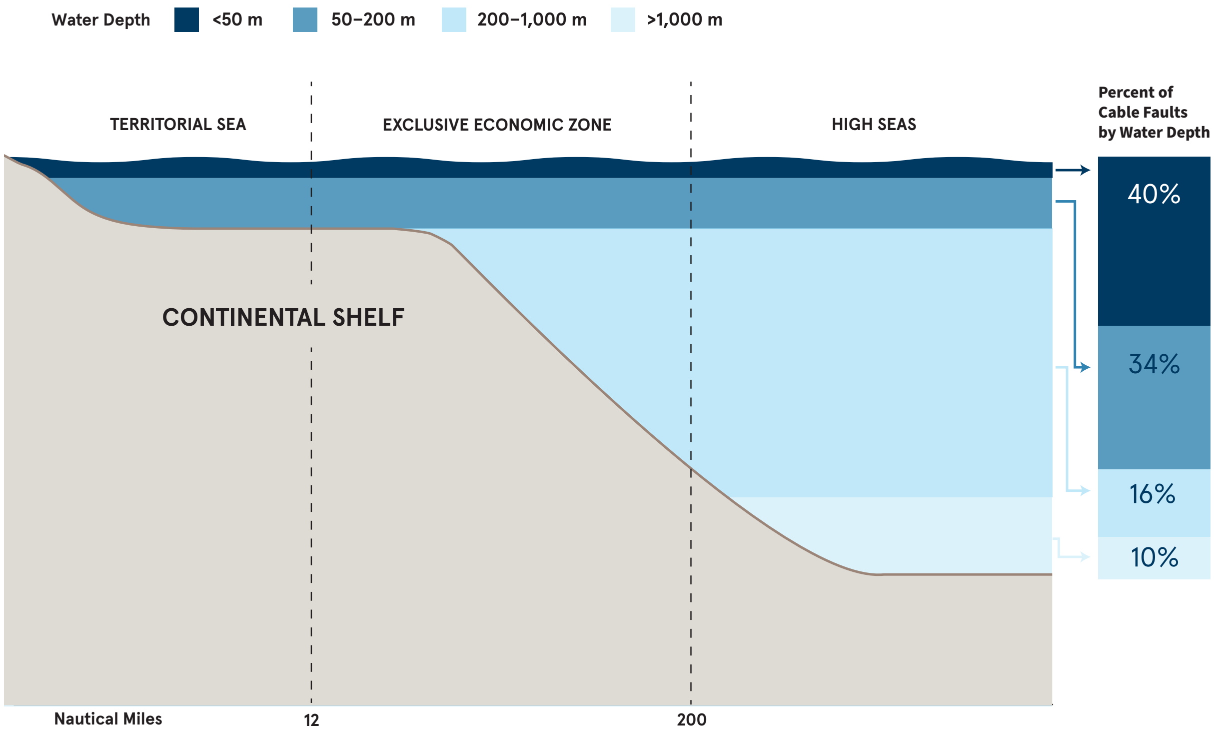
- **Intentional tampering:** Bad actors may tamper with undersea cables or their landing infrastructure because of tensions or conflict. These events are rare in Africa; however, several incidents have been reported in Europe in recent years. For example, in November 2024, two submarine internet cables in the Baltic Sea were disrupted. European officials blamed Russia, though the cable disruption was later attributed to a Chinese ship, raising concerns that China posed a threat to Europe's subsea cables.[34]

The Complexities of Cable Cuts

Not only can cable cuts occur for various reasons, but they can also happen at any point along the cable, from along the shore to deep on the ocean's floor. In the high seas, the cables lie at an average depth of 3,600 meters, and they can go down as far as 11,000 meters.[35] However, research has revealed that most cuts occur in the shallow waters (0–100 meters). In fact, the deeper the ocean, the smaller the likelihood of cable cuts (see figure 4).[36] Building resilience of undersea cables requires a nuanced approach with a particular emphasis on high-risk areas.

An additional challenge is the fact that undersea cables traverse multiple geographic and maritime zones, extending from terrestrial areas to the high seas. This means that cables span multiple national and international governance jurisdictions, which can create regulatory complexity and uncertainty. Although undersea cables are primarily a private sector investment, there are shared interests in their security, meaning their repair and efficacy requires a multistakeholder approach. Many different authorities are involved in subsea cables, including national authorities for telecommunications, security, and maritime areas. When a cable cut occurs, jurisdiction matters for many reasons, including for accessing undersea cables and for dealing with recourse. A key legal tenant for submarine cables is the United Nations Convention on the Law of the Sea (UNCLOS), which demarcates the ocean's boundaries and provides a legal framework for laying and repairing submarine cables (see figure 4).[37]

Figure 4. The Majority of Cable Faults Worldwide Occur Along the Continental Shelf



Source: International Cable Protection Committee, "A Global Comparison of Cable Repair Commencement Times: Update on the Analysis of Cable Repair Data," May 2024, accessible via subscription at https://www.iscpc.org.

Another complexity is that repairs are expensive. The cost of repairing a submarine cable averages between $1 million and $3 million and involves specialized cable ships with highly trained crews that cost tens of thousands of dollars per day, alongside the costs associated with replacing damaged cables and other expenses like permits.[38] In addition, it takes time to mobilize repair vessels, especially for African countries.[39] For instance, the first repair ship that responded to the West African cuts arrived after three weeks.[40] Globally, there are less than one hundred cable repair ships, and only three serve the African continent. Only one of those vessels (*Léon Thévenin*) is based at a port along the African coast. This creates complications, especially when the ship is already deployed to undertake other services across the continent, as happened in 2023 when two cables serving Southern Africa were severed off the coast of Democratic Republic of the Congo.[41]

How Can Africa Reduce Risks to Undersea Cable Cuts?

A harmonized and nuanced strategy developed by African stakeholders is needed. The protection, repair, and resilience of undersea cables can only be achieved through a multistakeholder, multisectoral approach that embeds interventions throughout the cable's life cycle and includes various players, such as governance units at the national and regional levels. This section details two strategies for reducing Africa's vulnerability to cable cuts: implement redundancy measures and create a new governance approach.

Redundancy Measures

Diversify routes. The Africa Finance Corporation in its State of Africa's Infrastructure Report 2024 notes that "for Africa's first mile infrastructure to be effective and resilient, it needs more diversity in routes."[42] The report brings attention to how the lack of diversity in subsea cable numbers and routes serving Africa has led to an overreliance on single-path connectivity solutions, raising the risk of internet outages when disruptions occur. This is particularly true for countries that only have one cable landing, including Guinea, Guinea Bissau, The Gambia, Liberia, and Mauritania (see figure 3). The lack of diverse routes heightens the risk of internet outages due to cable damage. Route diversification is advisable, particularly in regions such as the Red Sea, which hosts a significant number of undersea cable networks. In February 2024, the cables of four major telecommunications networks sustained damage along the Red Sea.[43] After a commercial vessel was struck by missiles near the western coast of Yemen, its crew released one of its anchors and abandoned ship. The vessel drifted for nearly two weeks and then sank in an area with many cables. Subsequent reports indicated damaged cables in the area.[44] The incident highlighted the need for Africa to establish more undersea cable network linkages or interconnections to avoid mass outages.

Increase interconnections. Undersea cables are designed to connect with each other and terrestrial networks. Additional strategic interconnections could provide alternate paths to reroute traffic in case one cable is damaged. This would foster resilience in African countries with limited cable landings by creating redundancy networks. Redundancy networks play a vital role by allowing traffic to be rerouted through alternative cables in the event of a disruption.

Establish cross-border circuits. Terrestrial cross-border circuits enable fiber optic backbone networks to cross national borders to neighboring countries through bilateral agreements. These cross-border connections allow countries to connect terrestrial networks from alternate undersea cables. In the 2024 West Africa incident, a cross-border circuit into Ghana and Benin from Togo facilitated the restoration of traffic, leveraging the Equiano cable landing in Lomé, Togo.[45]

Secure and diversify landing stations. The role of landing stations cannot be downplayed. A landing station is where an undersea cable comes to shore. Landing stations convert submarine cables into terrestrial cables and distribute the data carried on the networks. They also provide power to the subsea cables.[46] Undersea cables need high voltages to maintain signal strength over long distances.[47] Landing stations therefore require reliable power, and this has led to cable landings gravitating to where power and other resources are available. In most African countries, especially those with multiple cables, landing stations are concentrated in one area. For example, cables landing on Kenya's coast all land in Mombasa, increasing the risk and vulnerability from an event.[48] Studies show that landing stations are also more vulnerable to attacks than undersea cables.[49] They may be damaged by natural disasters, such as tsunamis, and human activity. Securing and diversifying landing stations is critical to increase redundancy.[50]

Utilize alternative technologies. Redundancy may be accomplished through diversification with alternative technologies, including satellite technology. Countries could invest in this technology, which could be particularly useful during cable outages as an alternative source for communication. However, they should keep in mind that satellite connectivity presents challenges, including inequitable data capacity solutions and limitations like high latency.[51]

Governance and Cooperation

Governance of subsea cables in Africa is made complex by the lack of a single regulatory regime for undersea cables. UNCLOS allows the thirty-eight African coastal countries to formulate laws and policies regarding undersea cables within their jurisdictions.[52] This means companies seeking to build cables have to interface with oversight and regulation entities in thirty-eight African countries with a coastline. For example, in West Africa, Ghana's National Communications Authority oversees the regulation of submarine cables through the Electronic Communications Act (2008),[53] and the Nigerian Communications Commission undertakes this mandate developing its own regulation.

Additionally, research indicates that most governance of undersea cables in African countries primarily occurs at the regulatory level, focusing primarily on the licensing of these cables.[54] This approach neglects other significant factors, including ecosystem-wide subtleties such as the need for an enabling environment to attract additional subsea cables investments as a tool for digital transformation. This regulatory approach has resulted in hefty permit fees for the private sector to lay cables, which can be counterproductive to the public interest of drawing in more undersea cables that can help secure resiliency. An examination of the neighboring countries of Kenya and Tanzania reveals that the Kenyan regulatory body's licensing fees for undersea cables is 15 million Kenyan shillings (equivalent to around $115,000), plus an upfront operating fee of up to 4 million Kenyan shillings (around $30,000). In Tanzania, the Communications Regulatory Authority imposes a licensing fee of $10,000 and an operating fee of $400,000 for an initial period of fifteen years.[55] In a continent seeking to enhance cable landings, it is essential to reassess the permitting framework to encourage long-term economic benefits.

At the national level, it is essential to ensure coordination among the different units of government. Undersea cables share the oceans with other economic activities, including fishing, shipping, oil, gas, wind, mining, dredging, marine tourism, research, and military activities, creating the need for coordination. Although UNCLOS outlines a framework of rights and responsibilities for countries regarding maritime zones that extend from the coast, it does not specify the precise methods for coordinating spatial and competing uses.[56] This leads to regulatory gaps and differences among countries. Engagement across government agencies and with private industry players is crucial. For instance, the routing of cables should consider other maritime activities, and these activities' regulators should be made aware of cable infrastructure—particularly the fishing industry, which is responsible for a significant number of cable cuts. Evidence of interagency coordination is already emerging. In Nigeria, following the West Africa outages, the Communications Commission engaged with the Nigerian Maritime Administration and Safety Agency to develop a harmonized regulation for submarine cables.[57]

There is also a need for African alignment with global best practices, including the Global Digital Inclusion Partnership's Good Practices for Subsea Cables Policy: Investing in Digital Inclusion and the Government Best Practices for Protecting and Promoting Resilience of Submarine Telecommunications Cables published by the International Cable Protection Committee (ICPC), the specialist body for undersea cables.[58] The ICPC offers guidance for governments, outlining general principles for cable management and suggesting actions that countries can take to enhance the resilience of submarine cables. It advocates for national authorities to concentrate on critical areas that would significantly reduce risks, promote regulations that would secure undersea cable landings, review permitting regimes and policies to ensure a regulatory ecosystem that is favorable for private investments, implement international treaty obligations regarding undersea cables, and foster frameworks that accelerate cable deployment and repair within established time frames. Additionally, it emphasizes the importance of close consultation with industry representatives to comprehend technology and operational parameters, as well as to enhance data sharing and cooperation among countries at both regional and global levels. These tenets can assist African countries in rethinking their undersea cable policies and undertaking policy action.

The following five governance-related recommendations borrow from these guidelines:

1. **Develop clear frameworks** that provide guidance for the deployment, maintenance, repair, and redundancy of undersea cables. The thirty-eight African countries with coastlines should create playbooks for the notification of incidents and have information-sharing frameworks for incidents, vulnerabilities, and threats.

2. **Designate a single point of contact for incident reporting**, a key recommendation from the ICPC. For instance, this could be an office that coordinates with all relevant agencies for issues relating to undersea cables, including deployment, repair, and protection.

3. **Increase marine spatial planning and interindustry coordination**. The ICPC recommends that countries can better protect undersea cables by spatially separating subsea cables from other marine activities. This can take the form of a submarine cable corridor that provides special protection for cables and prohibits other marine activities like fishing (unless there is an agreement to allow such an activity in proximity to the undersea cable).[59]

4. **Recognize subsea cable infrastructure as critical infrastructure**. This would provide extra legal protection, including penalties and fines for those that interfere with the undersea cable infrastructure and landing stations. It is worth noting that some African countries, such as South Africa, have established critical infrastructure laws that provide legal protection for undersea cables infrastructure.[60]

5. **Boost collaboration and cooperation nationally, regionally, and continentally.**

    - At the **national level**, collaboration and cooperation between government units and between the private and public sectors is crucial for the planning, deployment, maintenance, and repair of cables. Cooperation frameworks should support quick action in the event of cable cuts. For example, following internet outages caused by disruptions on SEACOM and EASSy, Kenya's regulatory authority instructed local telecom companies to implement proactive strategies to ensure alternative routing for their traffic.[61] The regulator's action facilitated a return to normalcy; however, it is essential for countries to establish cooperation agreements not just for incidences but for resiliency building. For instance, the United States automatically reroutes traffic in the case of a cable cut. Cable companies design cable systems to ensure that each node (connection point) connects to at least two other nodes on the network, offering opportunities to reroute traffic when necessary. Additionally, companies have agreements with other cable owners to transfer traffic between networks during outages.[62] Cable cuts are inevitable and sometimes unavoidable, but collaboration and cooperation can alleviate the effects of cable cuts at the national and regional levels.

    - At the **regional level**, collaboration between countries is critical to develop a unified approach to undersea cables. Regional collaboration can significantly contribute to the establishment of strategies aimed at safeguarding cables by facilitating the exchange of information and resources in response to cable cuts. Nigeria has promoted a unified multilateral approach through the West Africa Telecommunications Regulatory Assembly (WATRA), with the goal of protecting shared telecommunications infrastructure and enhancing connectivity to ensure seamless connections.[63] Furthermore, there exists a chance to draw upon various regional initiatives, including the African Maritime Rescue Coordination Centers located in Rabat, Cape Town, Lagos, and Monrovia. The centers are crucial for conducting search and rescue operations and gathering intelligence to reduce maritime risks along the African coast.[64] Governments could improve these centers by integrating the security of Africa's undersea cable networks.

- **Continentally**, the African Union (AU) should champion a harmonized legal and regulatory framework for undersea cables. The AU should lead the conversation around defining guidelines and best practices for the continent. The AU could convene a specialized working group on undersea cables that brings together experts on Africa's cables. This approach has taken shape at the United Nations with the launch of an International Advisory Body for Submarine Cable Resilience in November 2024.[65] The International Telecommunications Union and the ICPC launched the advisory body to foster dialogue and collaboration while enhancing the resilience of undersea cables.[66] The advisory body brings together a range of stakeholders, including government representatives, regulatory authorities, and industry leaders, to offer strategic guidance on enhancing undersea cable resilience, advocate for best practices, and foster international cooperation. It is cochaired by Nigerian Minister of Communications, Innovation, and Digital Economy Bosun Tijani, providing an opportunity for cross-pollination of ideas with the African Union.[67]

Conclusion

Undersea cables are the backbone of Africa's digital economy, but recent disruptions have exposed their vulnerabilities. To safeguard the continent's digital future, proactive measures are essential. There is a dire need for African countries to think and act as one to address the vulnerabilities in the continent's undersea digital infrastructure. This paper's two broad proposals—implementing redundancy measures and developing a new governance approach—would help accomplish this. Redundancy measures include diversifying routes, increasing interconnections, establishing cross-border circuits, securing landing stations, and utilizing alternative technologies. Governance measures should create a harmonized framework for undersea cables, designate a single point of contact for incident reporting, undertake marine spatial planning, and recognize undersea cables as critical infrastructure. Most importantly, building a resilient undersea cable infrastructure necessitates that governments take the lead and collaborate with the private sector and other stakeholders on the national, regional, and global levels. Ultimately, the emergence of a cohesive plan for Africa's undersea cables will only come through concerted government efforts.

About the Author

Jane Munga is a fellow in the Africa Program focusing on technology policy. Her career has focused on policymaking with an emphasis on the potential of digital technologies for digital development.

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