



Subsea Internet Cable: The Digital Infrastructure Connecting Global Communities

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Abstract: Subsea internet cables are the physical backbone of global digital connectivity, carrying more than 99% of intercontinental data traffic, although their physical numbers are relatively limited and most of their holdings are concentrated in a handful of consortiums and giant technology companies. This article reviews the role of subsea cable in supporting the digital transformation of global society, the accompanying geopolitical and security challenges in the wake of increasing incidents of sabotage and cable breakdowns, and its impact on the digital divide between countries. The study was conducted through a review of the narrative literature on academic research and recent think-tank reports on the governance, security, and economics of submarine cable infrastructure. The results of the review show that the three approaches that have dominated the discourse, namely the technical-infrastructure approach, national security, and economic development, each have both contributions and limitations, and are rarely studied in an integrated manner. This article concludes that a more holistic governance framework is needed, which balances technical, security, and equitable digital access considerations from the planning stage, so that the benefits of subsea cable connectivity can be felt equally by the global community, including archipelagic countries such as Indonesia.

Keywords: Submarine Cables; Subsea Internet Cables; Digital Infrastructure; Global Connectivity; Digital Divide

1. Introduction

In the digital age, the need for fast and stable internet connectivity is a fundamental need for the global community. Most people think that transcontinental internet communication depends on satellites, when more than 99% of the world's international data traffic is routed through a network of fiber-optic cables planted on the seabed [1], [3]. Subsea internet cables span more than a million kilometers, connecting continents, countries, and islands, while also being the almost invisible foundation of an interconnected world.

The development of subsea cable technology cannot be separated from the increasing need for data due to the growth of cloud computing, streaming, digital commerce, and real-time communication services. However, the huge dependence on physically limited infrastructure also raises new vulnerabilities, both in terms of technical, security, and equitable access. This perspective article aims to review the role of subsea cable in global connectivity, analyze the approaches that have been used to understand it, and convey the author's views on a more appropriate direction of governance in the future.

2. Materials and Methods

This study was prepared through a narrative literature review of peer-reviewed academic publications, cybersecurity research institution reports, and the latest telecommunications industry data on submarine cable networks. Sources were traced from international journals and official reports of think-tank institutions that specifically discussed geopolitics, security, and socio-economic impacts of subsea cable, then synthesized to identify dominant patterns of approach in current academic discourse and policy.

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3. Discussion

Fiber optic submarine cables are the backbone of the world's digital economy, transporting almost all international communication traffic, ranging from trillions of dollars per day worth of financial transactions, cloud services, to government and military communications [1], [3]. Studies of global networks show that the distribution of cables and landing points is highly spatially uneven: the United States and Europe are the main concentration centers, while the network's core connectivity is formed by only a handful of countries and strategic landing points such as Mumbai, Fujairah, Jeddah, Hong Kong, and Singapore [2].

Rising geopolitical tensions in recent years have transformed subsea cable from a mere telecommunications engineering issue to a national security issue. Studies show that cable network vulnerability increases in line with the lack of line redundancy and limited global repair capacity, especially amid geopolitical tensions such as the war in Ukraine and coercive activities in the Taiwan region [8]. The risk to cable has also been shown to vary with the intensity of geopolitical tensions, culminating in an ambiguous period between peace and open conflict, where certain parties take advantage of the ambiguity of attribution to carry out "gray zone" actions [4]. The long history of subsea cable also shows that power competition over cable lines and landing points has been going on since the colonial era, and this pattern is now repeating itself in a new form in today's great power competition [6]. A systematic review of the academic literature also shows that the cable security discourse has so far been divided into three narrow groups of studies, namely the threat of hybrid war and terrorism, technical issues, or regulatory issues alone, so the research agenda needs to be expanded to include security and geopolitical governance more comprehensively [3].

In terms of development, the existence of subsea cables has been empirically proven to increase internet penetration. Studies in Sub-Saharan Africa show that the construction of SEACOM, MainOne, and EASSy cables results in an increase in internet penetration by 3-4 percentage points, while reducing the digital isolation of countries without sea access, although exposure to seismic risks on these cable lines also increases countries' vulnerability to telecommunications disruptions [7]. However, these benefits are uneven: the structure of global submarine cable networks is pyramidal, with developed countries such as the United States and the United Kingdom occupying the top of the connectivity structure, while the majority of developing countries in Africa, Latin America, and Oceania are at the bottom layer with much more limited connectivity [2]. Research shows that subsea cable can reduce the global digital divide through three paths, namely infrastructure expansion, digital ecosystem reconstruction, and economic empowerment, but the governance of the global digital divide remains stagnant due to differences in digital strategies between countries and the absence of an integrated global governance system [2].

4. Conclusion

Subsea internet cable is not just an ordinary technical infrastructure, but the backbone of a digital civilization whose existence is paradoxical: it is vital yet almost invisible, it is very powerful to sustain the global economy but at the same time it is very vulnerable to a single disruption. A review of the three approaches that dominate the discourse, namely technical-infrastructure, national security, and economic development, shows that each has significant contributions and limitations, and the absence of a framework that integrates all three makes the resulting policies tend to be patchy.

Going forward, subsea cable governance needs to shift from a compartmentalized approach to a more holistic framework, where technical, security, and equitable access considerations are designed in a balanced manner from the start. For an archipelagic country like Indonesia, this is urgent: diversification of cable lines is needed to reduce the risk of single point of failure, strengthening domestic repair and surveillance capacity, and policies that ensure that cable infrastructure investment actually leads to increased people's digital access, not just making their territory a crossroads for the benefit of others.

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