Building a Shared Research Agenda on Submarine Cables

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Introduction

Submarine cables, both for data and power transmission, constitute the hidden backbone of digital and energy interconnectivity. As global infrastructures, they link continents, economies, and political regions, yet their routes, ownership structures, and strategic significance often remain opaque. On October 2, 2025, the critical infrastructure lab and Milan Babić organised a Submarine Cable Workshop at the University of Amsterdam to develop a shared research agenda on submarine cables.

During this one-day event, practitioners and researchers presented their work, shared insights, and openly discussed the challenges of studying submarine cables. Together, we reflected on the availability and accessibility of data and identified possible next steps. This report provides an overview of what was discussed and what we took away from these conversations. In this report, we use the term submarine cables to refer to internet connectivity cables that traverse oceans and lakes.

In the workshop, we discussed the lack of reliable data sources on submarine cables and their ownership structures, geopolitical tensions, and hype around sabotage, and how we can understand power relations around these infrastructures through digital colonialism. The following research areas were identified: develop new and consolidated datasets that include historical and detailed information on ownership structures; create a typology of submarine cables; and gain insight into the political negotiations to secure a landing station in a specific territory.

We share this report in the spirit of learning in the open—a guiding principle of the Lab's work.

Throughout this report, the term "we" reflects the collective nature of the discussions during the Submarine Cable Workshop. However, the critical infrastructure lab alone is responsible for any errors found herein. Where possible, we have linked to the participants' existing work. We were not always able to attribute remarks, findings, or opinions to individual contributors. Nevertheless, we acknowledge the labour, experience, and expertise that made these insights possible.

We want to thank the following workshop participants for their contribution: Emile Aben (RipeNCC), Valentina Carraro (UvA), Carolina Maurity Frossard (UvA), Sophie Hoogenboom (VuB), Fieke Jansen (UvA), Dmitry Kuznetsov (UvA), Virginie Mamadouh (UvA), Valentina Ochner (VU), Niels ten Oever (UvA), Sasha Pearson (ECDPM), Jane Ruffino (Södertörn University), Ouejdane Sabbah (UvA), Steve Song (ISOC), and Pablo Zagt Hernández (UvA).

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Figure 1. Submarine cable landing site, Svalbard, Norway (2012)

The material reality of submarine cables

The landing stations where sea cables connect to terrestrial infrastructure, are usually inconspicuous buildings that blend seamlessly into their surroundings.

Submarine cables are largely invisible infrastructures. They lie on ocean floors or beneath large lakes, and long before they come ashore, they are buried underground to protect against damage caused by anchors or natural phenomena. The landing stations, where sea cables connect to terrestrial infrastructure, are usually inconspicuous buildings that blend seamlessly into their surroundings.

There are different ways to discuss the materiality of these infrastructures. Broadly, one can distinguish between two types of submarine cables: long-haul cables, which include power sources, and short-haul cables, which do not. In the workshop, it was noted that most cables are relatively short, while only a few extend beyond 5,000 kilometres. Each type requires a specialised fleet of ships to lay, maintain, and repair the cables and has its own layered set of infrastructures.

Ownership is another dimension. Specifically, who manufactures and owns the material composition of the cables themselves. Cables typically include a combination of fibre optics, insulation, power sources, amplifier stations, and landing stations. There are a few companies that produce submarine cables. While most produce both repeater and unrepeater systems, Jane Ruffino notes that Hexatronic is the only cable manufacturer that only produces unrepeatered short-haul cables (although most of their business is in terrestrial cable). Landing stations are particularly interesting as they embody the outcome of a range of political and industrial negotiations.

Political negotiations determine, for instance, what is traded or agreed upon for a particular country, and not its neighbouring nation, to become a cable landing site. These negotiations relate to the layered nature of infrastructures, where Ouejdane Sabbah, Carolina Maurity Frossard, and Fieke Jansen noted that the locations of submarine cables' landing spots are increasingly connected to the political business climate for data centres and available electricity network infrastructures. Industry negotiations concern who has physical or digital access to the cable. Can network providers (ISPs or backbone networks) install their own hardware in the landing station, or must they access the infrastructure virtually through a machine provided by the cable owner?

Figure 2. Submarine cable landing site, Rostock, Germany (2016)

Opaque ownership structures are connecting continents

Submarine cable networks are a crucial component of global infrastructure, carrying approximately 97% of global internet traffic (Rossiter 2023). During the discussions, many participants noted that while these cables appear to seamlessly connect continents, their governance and ownership structures are far more complex. The submarine cable industry itself is relatively small, primarily because laying and maintaining these cables is extremely expensive. "The costs for subsea telecommunication cables range from approximately €25,000 to €45,000 per kilometre".[1] As a result, only a limited number of governments and corporations have the capacity to invest in their deployment. Importantly, the investors are not always the owners or operators of the cables.

Compared to terrestrial fibre networks, there are significantly fewer submarine cables in operation. The technical challenges of deploying thousands of miles of undersea cable make them much more expensive than their terrestrial counterparts. According to the most widely cited database, TeleGeography, there are currently more than 600 active and planned submarine cables worldwide, each with an expected design life of around 25 years. The high costs, long lifespans, and limited number of cables make their routes and landing points strategically significant locations.

Milan Babić illustrated that there are distinct historical patterns in cable ownership.[2] From the 1980s to the early 2000s, submarine cables – particularly transatlantic ones – were primarily financed and owned by telecommunications carriers and international consortia. From the late 2000s to the mid-2010s, Chinese and other Asian state-owned firms began investing heavily in Asia-Pacific cables. Since the late 2010s, a new phase has emerged in which global routes, including newly created ones, are increasingly financed and operated by a mix of Western hyperscalers, Chinese state-owned enterprises, and large telecom corporations. This marks a notable shift from primarily consortium-based ownership models to a landscape that includes different ownership structures and, with it, new dependencies.

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There is little publicly available information about who owns, finances, and operates specific submarine cables. Authoritative data sources are, to put it mildly, incomplete, fragmented, or proprietary. Inaccessible data sources create an information asymmetry, preventing researchers and other public interest groups from assessing key questions around ownership, dependency, and control. For example, when examining ownership structures, participants noted that existing datasets typically provide only a snapshot of who currently owns a cable. They rarely include historical records of ownership changes or details about the structure of ownership—such as who initially invested in the cable, who manages its operations, or how access to its capacity is leased or shared.

Across the discussions, there was a shared recognition of the urgent need for more comprehensive and transparent data on cable ownership and governance.

Figure 3. Submarine cable landing site, Cook Strait (South Island), New Zealand (2021)
Public domain © Pseudopanax

01 Joint Research Centre. 2025. "Subsea Cables: How Vulnerable Are They and Can We Protect Them? - The Joint Research Centre: EU Science Hub." *Joint Research Centre*, "The JRC Explains". August 8. https://joint-research-centre.ec.europa.eu/jrc-explains/subsea-cables-how-vulnerable-are-they-and-can-we-protect-them_en.↩

02 Abels, Joscha, and Milan Babić. 2026. "Cable Wars? Mapping the Political Economy of Submarine Cables in an Era of Geoeconomic Competition." *Globalizations*, SI-Transnational Infrastructures in Geoeconomic Competition, 1-26. https://doi.org/10.1080/14747731.2025.2599691.↩

Hype and ambiguity surrounding submarine cables

There was a shared frustration among participants that geopolitical tensions contribute to the hypes and myths surrounding submarine cable breakdown. One example discussed was the rupture of two submarine cables in the Baltic Sea on November 17-18, 2024, widely framed as a case of Russian sabotage. Finland reportedly charged Russia's "shadow fleet" for damaging the cables through purposeful anchor dragging.[3] However, what is often overlooked in this narrative is that submarine cables frequently break due to accidental anchor dragging or natural causes. Europe alone "experiences approximately 100 cable fault incidents per year".[4] Despite this, the Baltic Sea events were perceived as exceptional, an act of sabotage requiring urgent measures to ensure uninterrupted connectivity.

Yet, when we move beyond the hype and examine actual traffic data, no latency or packet loss was observed following the incident. The internet functioned as designed and "managed to route around the damage that occurred".

Yet, when we move beyond the hype and examine actual traffic data, no latency or packet loss was observed following the incident.[5] The internet functioned as designed and "managed to route around the damage that occurred".[6] Ample terrestrial fibre capacity provided sufficient backup to maintain network resilience and handle the disruption effectively. This stands in contrast to the recent Red Sea outage, where on November 6, 2024, four damaged cables led to significant internet disruptions across the region.

Evidently, network resilience and reliable connectivity are not the only factors shaping infrastructural responses. Technical justifications interweave with geopolitical anxieties, determining which vulnerabilities become salient and which projects are pursued. Vietnam's new terrestrial cable to Singapore (VSTN) illustrates this dynamic. The VSTN is presented as the solution to the disruptive fragility of undersea cables and the technical complexity of their repair. The Vietnam Posts and Telecommunications Group (VNPT) gains the operational autonomy needed for rapid repair, independent from "foreign partners". In turn, full ownership supports Vietnam's data localisation and data protection requirements.

Sovereignty once meant legitimate authority rather than control. Now it is increasingly invoked in discussions of access to, control over, or ownership of infrastructure. The physicality of cables offers a means of presenting such control as legitimate authority, as ephemeral flows of bits are grounded within bordered space and made governable. How submarine and terrestrial routes interact, and where data "lands" within territorial jurisdiction, shapes not only network topology but the material terms on which digital governance can be exercised.

Figure 4. Submarine cable landing site, Cox's Bazaar, Bangladesh (2006)

03 Qiu, Winston. 2025. "Finland Charges Russian-Linked Ship Officers Over Baltic Sea Cable Sabotage - Submarine Networks." *Submarine Cable Networks*, August 13. https://www.submarinenetworks.com/en/nv/insights/finland-charges-russian-linked-ship-officers-over-baltic-sea-cable-sabotage.↩

04 European Commission. 2024. "Subsea Telecommunication Cables Are Essential for Europe's Digital Connectivity." European Commission. *Shaping Europe's Digital Future*, November 18. https://digital-strategy.ec.europa.eu/en/library/subsea-telecommunication-cables-are-essential-europes-digital-connectivity.↩

05 Aben, Emile. 2024. "Does the Internet Route Around Damage? - Baltic Sea Cable Cuts." *RIPE Labs*, November 20. https://labs.ripe.net/author/emileaben/does-the-internet-route-around-damage-baltic-sea-cable-cuts/.↩

06 Ibid.↩

Maps, representation, and power

It is therefore important to examine what incentives African states and industries have to engage with these cable systems, and how the resulting shifts in traffic flows, economic structures, and content ecosystems may reshape regional digital futures.

Digital colonialism as well as digital sovereignty provide important lenses for understanding recent infrastructural investments in Africa, such as Meta's and Google's submarine cable projects 2Africa and Equiano, which, as Ouejdane Sabbah notes, raise complex questions around power, access, and control. These projects are often framed through ambiguous discourses of digital sovereignty: on the one hand, they promise the localisation of data within national borders and increased connectivity; on the other, they risk new forms of enclosure and are sometimes criticised for reinforcing economic dependency on foreign technology companies. At the same time, it would be a mistake to approach these developments solely from a critical perspective without considering African viewpoints, as this risks a double erasure of local agency and strategy. It is therefore important to examine what incentives African states and industries have to engage with these cable systems, and how the resulting shifts in traffic flows, economic structures, and content ecosystems may reshape regional digital futures.

In regions described as having "new geographies of connectivity," Carolina Maurity Frossard observes that these developments are often framed as bypassing older infrastructures, even though they frequently retrace historical telegraph cable paths and established shipping routes. This dynamic highlights important differences between major players such as the EU and India and other regions that are negotiating forms of independence from the long-standing dominance of the United States and China. It is therefore crucial not to continually reify the centrality of US-China competition but instead to pay attention to what is unfolding elsewhere and how these local and regional initiatives are reshaping global connectivity. An illustrative example is Praia do Futuro in Fortaleza, Northeastern Brazil – a submarine cable hub where historically entrenched North-South connections converge with emerging South-South routes.[7]

Virginie Mamadouh presented a visual analysis of how submarine cables are depicted across different maps and graphic representations, showing how these visual choices shape public and professional understandings of what cables are, how they function, and what kinds of geopolitical or economic narratives they support. During the data collection, the pervasiveness of the visualization by TeleGeography was overwhelming, which is often borrowed by other actors to represent subsea cables, even when maps focus on a specific region or cable. By examining variations in scale, colour, emphasis, and spatial relationships, Mamadouh demonstrated that representations are never neutral but actively contribute to how these infrastructures are imagined, valued, and governed.

Figure 5. Submarine cable landing site, Waterville, Ireland (2018)

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07 Gomes de Jesus Neto, Antonio. 2018. "Do tráfico de escravos à internet: rotas sul-atlânticas, integração territorial e a nascente geografia dos cabos submarinos." *Boletim Goiano de Geografia* 38 (3): 473–90. https://doi.org/10.5216/bgg.v38i3.56347.↩

Research approaches and methodologies

The study of submarine cable infrastructures benefits from a wide and interdisciplinary methodological toolkit, many of which were actively applied by the workshop participants. Mapping plays a central role, drawing on datasets such as those from TeleGeography, as well as critical cartographic approaches that interrogate how cables are represented and what political, economic, and spatial narratives these representations privilege. Site visits to cable landing stations and coastal landing points offer grounded insights; cables are often discreetly marked or labelled, and observing these sites helps connect abstract network diagrams to material geographies. Complementary approaches such as measuring, tracing process and path dependencies, and event ethnography help capture how decisions are made, negotiated, and stabilised over time.

Research on cables can also be enriched through desk research and interviews with industry actors and regulators, along with discourse analysis of policy documents and media coverage to understand how cables are framed and contested. Historic cartography and company or industry research journals provide valuable archival material, while oral histories with retired or retiring cable professionals reveal perspectives and tacit knowledge that rarely surface in official narratives.

A range of additional methods further broadens analytical possibilities. Participant observation or internships within industry settings can offer access to everyday practices and organisational cultures. Longitudinal approaches that follow a cable from early planning stages through construction, operation, and eventual decommissioning provide a full lifecycle perspective. Embedding submarine cable analysis within the wider ecosystem of digital infrastructure, including terrestrial fibre links, internet exchange points, data centres, and regulatory regimes, allows for conjunctural and institutional analysis that situates cables within broader sociotechnical assemblages. Finally, technical methods such as mapping IP links or autonomous systems to specific submarine cables can help align network diagrams with physical infrastructure and offer a powerful cross-scale perspective on how global connectivity is materially produced.

Figure 6. Submarine cable landing site, Landeyjarsandur, Iceland (2024)

Next steps

At the end of the workshop, several clear pathways for future work were identified.

Datasets: Participants expressed a shared sense of relief in acknowledging that existing datasets on submarine cables are unreliable and incomplete. Moving forward, there is a strong desire to examine the provenance of current datasets and to develop a new, consolidated one that provides a comprehensive overview of the cables themselves, their capacity, and ownership structures.

Methods: A better integration of multiple methods is needed to get a clearer view of submarine cables. This is because the data is currently not available, knowledge and experience are disappearing and becoming more securitised, and access is hard.

Ownership Structures: To better understand trends, dependencies, business models, and tensions in the subsea cable industry, participants highlighted the need to gather detailed information about who invests in and owns which cables, the history of ownership changes, and how cable capacity is leased to third-party companies.

Typology: Another proposed direction is the creation of a typology of subsea cables and ownership structures. Such a framework would help clarify the diversity of cable types, investment models, and governance arrangements across different regions.

Landing Stations: As critical political and infrastructural sites where submarine cables enter territories, landing stations were identified as a priority area for further research. The workshop outlined four main research questions:

1. Where exactly do the cables land?
2. How do ISPs and networks gain access to submarine cables? Do they gain access through physical access to the buildings or virtual access to the racks?
3. How are landing station negotiations conducted, where, and by whom? What is being traded in these processes?
4. How do submarine cables, landing stations, and energy networks intersect?

Figure 7. Submarine cable landing site, Taizi Village (Kouhu Township), Taiwan

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