Digital Partnerships in Action (DPA)

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Study on the benefits and opportunities of Arctic Connectivity submarine cables for secure, resilient and sustainable global connectivity

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Executive Summary

Despite the global submarine fiber-optic cable network being a critical infrastructure that contemporary societies depend on, its composition and development have traditionally been based on decisions made by private companies. However, increasing geopolitical tensions, a growing understanding of the national strategic interests, and the identified need to ensure that this infrastructure remains under the control of trusted parties have led public authorities to pay greater attention to the network, which suffers from overconcentration and lack of diversity. Although these problems have been identified already many years ago, the submarine cable industry has been reluctant or unable to solve them.

This study analyzes the benefits, opportunities, challenges, and demand of the trans-Arctic submarine fiber-optic cables with attention also paid to security, resiliency and sustainable global connectivity. Besides identifying potential customers and users, this study compares the Arctic routes with the existing routes between the EU and Japan. While focusing on Japan, this study discusses the position and benefits of trans-Arctic cables to the US and Canada. In addition to this, this study identifies and analyzes the position of key stakeholders in Japan, and investigates the possibilities and challenges related to the Arctic SMART cables.

The policy recommendations for the EU in its interaction with Japan and other partners range from remarks concerning the readiness to compromise and the necessity of proceeding with the first trans-Arctic cable, which is to provide a proof of concept, to the need to explain the relationship between the different Arctic cable initiatives the EU is supporting. While, in the case of the Far North Fiber project, it may be advisable to integrate new companies into the European and Japanese teams developing the project, the Polar Connect project is in urgent need of a clear organizational structure and business plan. Furthermore, the EU should encourage projects generating new data flows between Europe and Japan and potentially also allow greater earning possibilities for Japanese companies in the construction and installation of the Arctic cables. Besides referring to the potentially important role of Hokkaido region, the recommendations pay attention to different approaches that are needed when justifying the trans-Arctic projects to Japanese and North American partners.

This report follows the principles of the Japan-EU Digital Partnership and the Japan-EU Connectivity Partnership and aims to provide relevant knowledge and practical tools contributing to the effective implementation of these collaborative frameworks.

1 Introduction

As submarine fiber-optic cables cover more than 99% of intercontinental communications they can be described as critical infrastructure contemporary societies depend on. The need for new submarine cable capacity, globally and between Europe and Japan, is predicted. The EU-Japan Digital Partnership recognizes that the routes via the Arctic Ocean may reduce network latency, bring long-awaited diversity to the global submarine cable network, and stimulate data flows between Japan and the EU, as well as between Europe and Asia. This is ever more important given that at present 90% of the direct Asia-Europe digital traffic travels through the Suez Canal, where disruptions and security issues are undermining safe and secure connectivity.

Both the problems in the global submarine cable topology and the advantages and merits related to trans-Arctic submarine cables have been identified years and even decades ago. However, only a limited effort has been made to solve the overconcentration problem and all trans-Arctic cable projects have either failed or at least been seriously postponed. At the same time, the new geopolitical importance attached to submarine cables, combined with conceivable new threats and an increasing number of suspicious incidents resulting in cable damage, has underscored the need to reconsider the roles of, and possible collaboration between, the private and public sectors.

While the Arctic Ocean offers unique benefits and possibilities to secure resilient and sustainable global connectivity, plans to develop new cable routes through this extraordinary environment include many uncertainties. While the public-private partnerships could help to de-risk these initiatives to attract private investments and encourage potential anchor customers, such arrangements should be based on informed decisions.

Background and policy contexts

The Japan-EU Digital Partnership and the Japan-EU Connectivity Partnership form the main European policy context for discussion and decision-making concerning trans-Arctic submarine fiber-optic cables. The Digital Partnerships between the EU, Japan, Republic of Korea and Singapore are overarching frameworks to strengthen connectivity and interoperability of digital markets and policy frameworks, as well as to facilitate digital trade. At the first Japan-EU Digital Partnership Council meeting on 3 July 2023, the EU and Japan signed a Memorandum of Cooperation to support secure, resilient and sustainable submarine connectivity (MIC 2023). In particular, they agreed to jointly promote actions to develop submarine cable connectivity via the Arctic, providing secure and high-quality connectivity between the EU and Japan, with the potential to extend it to Southeast Asia and the wider Pacific region. The Partnership is aiming at the provision of high-level technical expertise and advisory services in support of digital policy and regulatory convergence between the EU and the partner countries, strengthening stakeholder engagement, outreach and policy coordination with the partner countries, and raising awareness and sharing knowledge and information. The Digital Partnerships in Action (DPA) project aims to support the EU in the implementation of the Digital Partnerships with Japan (as well as Republic of Korea and Singapore), seeking the alignment and convergence in different areas of the digital economy to facilitate connectivity, trade and cooperation for a human-centric digital transformation of the society.

Besides the Japan-EU Digital partnership, there are also other Japanese policy contexts that relate to the trans-Arctic data cable initiatives. In recent years, the Japanese Government has promoted the decentralization of data center industry to strengthen the resilience of such infrastructures against natural disasters and encouraged the shift toward the utilization of renewable energy sources. As part of this process, the Japanese Government has established an **Expert Group on the Development of Digital Infrastructures (composition: APPENDIX 1) that gathers experts, representatives of private companies as well as personnel from the ministries and agencies involved in digital infrastructures development**. The reports (METI 2023a; METI 2024) prepared by the group concluded that digital infrastructure has been developed under the leadership of the private sector and emphasized the necessity of collaboration between the public and private sectors to create a comprehensive national plan for infrastructure from a medium- to long-term perspective.

The report noted that over 80% of domestic data centers are concentrated in the Tokyo and Osaka areas, and the landing stations of international submarine cables are concentrated in a few key locations. To overcome these problems, the need for new cable connections to North America and Europe, as well as the need to develop Hokkaido and Kyushu as new data hubs, was recognized. It is thus recognized that, besides providing subsidies to attract new (AI) data center investments into Hokkaido and Kyushu, there is also a need to improve their international connectivity (METI 2023b) The reports also referred to the trans-Arctic fiber-optic cables, mentioned geographical and geopolitical aspects, which may help Japan to become a hub for international data traffic between North America, Europe, and the Asia-Pacific region, and pointed out Hokkaido's advantageous position vis-à-vis the planned Arctic cables. The most recent report (Interim Report 3.0) was published at the beginning of October 2024 and explained past decisions of the Ministry of Internal Affairs and Communications (MIC) and the Ministry of Economy, Trade, and Industry (METI) to support various data center projects in Hokkaido and Kyushu. The report also hinted that further projects with government backing may be expected in the future. The Digital Infrastructure Development Fund was identified as an instrument through which the further promotion of public-private partnerships is expected.

The MIC established the Digital Infrastructure Development Fund in the FY2021 supplementary budget to support the development of data centers, submarine cables, and other related infrastructure. After selecting seven data center projects to be supported in June 2022, the MIC increased support for the development of international submarine cable landing stations and branching lines in the FY2023 supplementary budget. According to its rules, the Fund can support data centers, and landing stations in areas outside the Tokyo region (all of Tokyo, Saitama, Chiba, and Kanagawa), domestic submarine cables in areas other than the Pacific side, and international submarine cable branching lines and branching devices in landing areas outside of Boso Peninsula (where Chikura, Maruyama and Minamiboso are located) and Shima (METI 2024, MIC 2024a).

Japan announced its first Arctic Policy in 2015. The short policy document, prepared by the Headquarters of Ocean Policy (part of the Prime Minister's Office), emphasized science and technology, international cooperation, the environment and sustainable development, the respect of Indigenous peoples, the potential of the Northern Sea Route for shipping, and a stable security environment. The Arctic policy has never been revised. However, Japan updates its approach regarding the Arctic when rewriting the Basic Plans on Ocean Policy. These documents, revised once in five years, have a section dedicated to the Arctic. Neither the Arctic Policy (The Headquarters of Ocean Policy 2015), the Third Basic Plan on Ocean Policy (Cabinet Decision 2018), nor the Fourth Basic Plan on Ocean Policy (Cabinet Decision 2023) refer to trans-Arctic cables. Meanwhile, the Arctic strategy of China, published in 2018, mentioned China's (and other non-Arctic states') rights of laying of submarine cables (The State Council, The People's Republic of China 2018).

The **SMART (Sensor Enabled Scientific Monitoring and Reliable Telecommunications, sometimes also Science Monitoring and Reliable Technology) cable initiatives** have been discussed especially among the European scholars researching the Arctic. Unfortunately, this topic has not neither sparked interest nor been incorporated into the activities of the Japanese Arctic studies community, despite the concept being widely introduced at the Arctic Circle Japan Forum, for example. The European interest in the Arctic SMART cables has been introduced (by the author) to Japanese researchers when the next Japanese Arctic Studies National Flagship Project (expected to start in FY 2025) has been planned and Japan's contribution to the 4th International Conference on Arctic Research Planning (ICARP IV) process has been prepared. Japan's Ocean policy makes a few remarks about submarine cables when discussing the promotion of marine science and technology, safety measures for international submarine cables and landing stations, and real-time observation data related to earthquake and tsunami observation network. The last point is elaborated on by stating that submarine observation networks capable of real-time monitoring of earthquakes and tsunamis (such as S-net and DONET) will be operated and the new (N-net) observation network will be constructed (Cabinet Decision 2023; more information concerning these projects: CEV 2019; NIED 2024). The lack of interest in SMART cables among Japanese Arctic scholars may be related to the attention given to, and the high expectations surrounding, the long-awaited research icebreaker (JAMSTEC 2024), which is expected to be completed at the end of 2026.

Japan's Diplomatic Bluebook (MOFA 2023) reveals that the enhancement of connectivity belongs to general targets of Japan's foreign policy. The most visible initiatives Japan has made at international forums are related to the concept of **Data Free Flow with Trust (DFFT)**. DFFT aims to promote free cross-border data flows for economic growth and technological innovation while recognizing the need for trust-based mechanisms to address concerns related to data privacy, cybersecurity, national security, and intellectual property rights. After Japan proposed the creation of an international order for the Data Free Flow with Trust in January 2019, the concept has been discussed at multiple international diplomatic forums and among private sectors. DFFT was mentioned at the G20 2019 Osaka Summit and the Roadmap for Cooperation on DFFT was approved at the 2021 G7 Summit. The G7 Action Plan for promoting DFFT was formulated in 2022 and the establishment of an international framework with a permanent secretariat to facilitate the DFFT was agreed in 2023 (Digital Agency 2024). Japan's 2021 Comprehensive Data Strategy (Digital Agency 2021) confirms Japan's commitment to DFFT and refers to international collaboration but lacks detailed discussion concerning submarine cables.

At the bilateral level, **Japan advances its international connectivity aspirations through digital partnership agreements**. Besides the partnership with the EU, Japan launched the Global Digital Connectivity Partnership (GDCP) with the US in 2021. GDCP builds upon previous cooperation through the Japan-US Strategic Digital Economy Partnership (JUSDEP) but aims to expand the scope of discussions to promote secure connectivity and vibrant digital economies. The objectives of the initiative also include cooperation in third countries and enhanced collaboration in multilateral forums (US Department of State 2021). The concrete activities, achievements, and active contributors of the GDCP have been difficult to identify. It seems to have received the greatest attention in Japan at the time of its inauguration. When GDCP has been mentioned, references have focused on the advancement of 5G and Open RAN (MIC 2022; US Department of State 2023), rather than on submarine cable infrastructure. However, this initiative was mentioned in the February 2024 Joint Statement from the 14th Japan-U.S. Dialogue on Digital Economy, which also reaffirmed the importance of promoting secure and reliable global submarine cable networks (MIC 2024b). Another example of Japan's international activity is the initiative called "Japan-UK Digital Partnership Council, established in December 2022 (GOV.UK 2024).

Objectives of the study, scope of analysis and methodology

The aim of this study is to analyze the benefits, opportunities, challenges, and demand of the trans-Arctic submarine fiber optic cables with attention also paid to security, resiliency and sustainable global connectivity. The questions this study attempts to answer can be broadly divided into five categories, reflecting the different objectives. The first objective is to identify the potential customers and analyze the demand of the Arctic route from the perspective of business users, research-based organizations, defense and security interests. The second objective is to compare the Arctic routes with the current routes passing through the Middle East and Asia and to assess how Arctic connectivity can contribute to DFFT and the resilience of the connectivity between the EU and Japan, and beyond. While focusing on Japan, this study also discusses the position and benefits of trans-Arctic cables to the US and Canada. The third objective is to summarize the position of various public and private stakeholders in Japan, and to consider which Japanese partners need to be involved and engaged. In addition to this, the report investigates the possibilities and challenges related to the Arctic SMART cables and provides policy recommendations for the EU in its interaction with Japan and other partners.

This study on Arctic connectivity is based on qualitative content analysis, a research method used to systematically analyze qualitative data to identify patterns, themes, and meanings. This study employs data triangulation and incorporates various forms of material from multiple sources to increase the reliability of the results and enable observations that might remain unnoticed if utilizing narrower source material. While analyzing information from different types of sources, attention is paid to the source's purpose and functional connections.

Comparative analysis is conducted when analyzing lessons to be learned from the past or ongoing but delayed trans-Arctic fiber-optic cable projects. The comparative approach helps to identify questions and features that might otherwise be missed, to clarify the profiles of individual cases by contrasting them with other occasions, and to produce and criticize causal explanations. Besides comparison, it is also possible to analyze the process of mutual influencing, i.e. how different trans-Arctic cable projects have impacted each other. The scope of the report sets limits to detailed information that can be provided concerning regulation and relevant policy instruments especially in the US and Canada. Nevertheless, the report outlines the features necessary to understand the overall context for the development of trans-Arctic cable projects.

The collection and analysis of the relevant data consists of the following processes:

- Review of the existing academic research literature.
- Review of the existing articles in the cable industry relevant publications (such as Submarine Telecoms Forum, Capacity Media, Data Center Dynamics (DCD) etc.).
- Review of the relevant reports, policy papers, and strategies from public authorities (focus on Japan as the documents from the EU-side are most likely familiar to the subscriber of the report).
- Review of the recent trans-Arctic cable related discussion in popular print, broadcast and digital media.
- Participatory observation and informal discussions with relevant stakeholders (Examples from the autumn of 2024: Polar Connect: Opportunities for a long-term Arctic Observatory, 7 October 2024 (online), organized by Swedish Polar Research Secretariat, Swedish Research Council, and NORDUnet; Participation in discussions between the Hokkaido Government and Cinia in Helsinki; Observing Polar Connect project's Session at the Arctic Circle Assembly and discussing with participants in Reykjavik; Observing and discussing with the participants of the 'Japan-Europe Forum on Recent Data Center Trend' organized by Hokkaido Nutopia Data Center Study Group, Hokkaido University and Hokkaido Government in November 6, 2024).
- Formal interviews with representatives of the cable industry were conducted before this assignment, but new interviews were not conducted when preparing this report.

2. Problem Statement

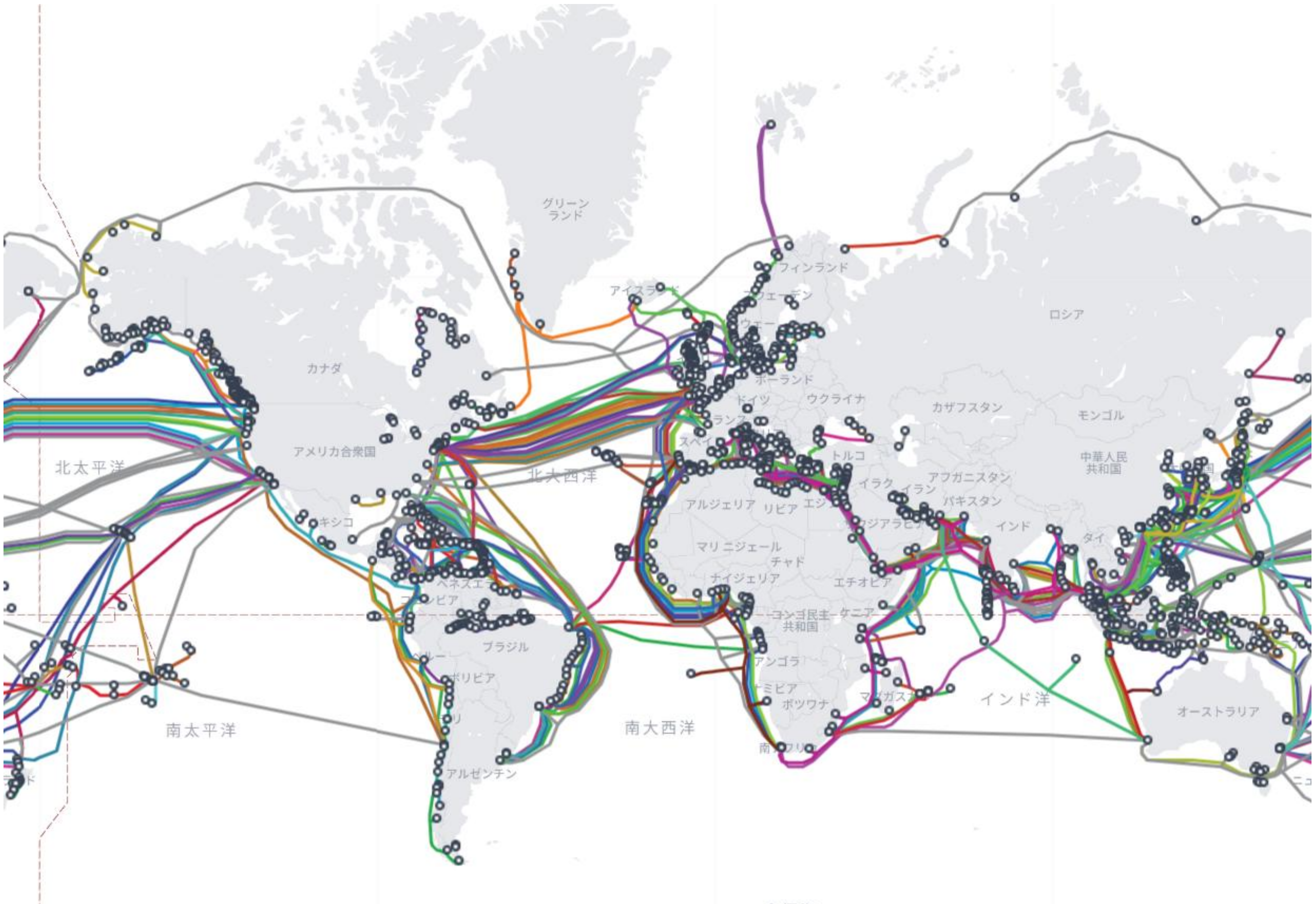
Description of the rationale of the analysis

The need for new submarine fiber-optic cable infrastructure in the Arctic region has been long acknowledged. The Arctic Council (intergovernmental forum promoting cooperation in the Arctic where Japan is acting as observer)'s Task Force on Telecommunications Infrastructure in the Arctic highlighted the various needs in local communities and pan-Arctic societies already in 2017 (Arctic Council 2017). Similar kinds of demands for the improved Arctic connectivity have been repeated in the Arctic Economic Council's reports (Arctic Economic Council 2017; Arctic Economic Council 2021) and in the 2021 Declaration of the Arctic Council's Ministerial Meeting (Arctic Council 2021). However, none of these reports have included any input from Japan or any other non-Arctic state.

Besides the needs of the Arctic communities, the rationale behind the trans-Arctic projects and this report, stems from the possibility to solve or ease the existing problems in the global submarine cable networks, and to meet to the future needs for resilient low-latency connectivity between Europe, Japan and areas beyond. The public authorities' increased interest in the Arctic connectivity can be understood both as a part of the wider identification of submarine cables as critical infrastructure societies depend on, and as a sign of uncertainty concerning the existing market-driven mechanisms' capability to provide desirable outcomes. The current global submarine fiber-optic cable network, with its many faults, is an outcome of decisions made mainly by private profit-seeking enterprises and there is no international governing body overseeing the development of the cable network.

Evidence or data supporting the existence of the problem

The global submarine cable map, based on the authoritative data found in TeleGeography's Transport Networks Research Service, describes **the problems related to overconcentration and choke points in traffic between Europe and Japan**. However, it is important to notice that the cable routes on the map are stylized and do not reflect the actual cable paths in detail. The map also consists of both existing cables (various colors) and planned projects such as the Far North Fiber and Polar Express (grey color).



Any reference to TeleGeography's Submarine Cable Map, URL, or any screen capture of the map is made available under the Creative Commons License: Attribution-ShareAlike 4.0 International (CC BY-SA 4.0). https://www.submarinecablemap.com

The routes of various submarine fiber optic cables are similar, and they often utilize the same landing stations, because the companies involved have wanted to maximize their connections with the existing cable systems. The utilization of old routes also means that data about the environmental conditions, ranging from the seabed topography and sediment types to the possibility of natural hazards and their recorded effects on infrastructure, is already available. Furthermore, problems concerning zones where fishing and anchoring are limited or banned, as well as questions concerning the environmental impacts on the shoreline, for example, are often solved if following the route utilized already before (Starosielski 2015; Saunavaara and Salminen 2023).

Besides being faster and cheaper to develop, the maintenance of the often-used routes is also easier as the limited number of cable ships capable of repairing the damaged cables are typically located in areas with high cable density. The maintenance of submarine cables is based on two types of agreements. The Zone Agreements are based on a model where several cable owners collaborate, share service and set up regional maintenance agreements. These agreements divide the oceans and seas into areas that are serviced by designated vessels, which are in strategic points within the zone. The Private Maintenance Agreements are provided by recognized service providers that offer services to individual cable owners based on the conditions of bilateral contracts. Both types of agreements usually have a payment system consisting of the regular/annual standing charges and running costs that are to be paid when services are requested for a repair operation. The average reported repair time for submarine cable faults fluctuates but the general trend during recent years has been upward. In 2023, the average repair time was 40 days (Ford-Ramsden and Burnett 2014; Submarine Telecoms Forum 2024a).

The trans-Arctic cables would pass through several zones (Atlantic Cable Maintenance Agreement (ACMA); North American Zone Cable Maintenance Agreement; and Yokohama Zone) and private maintenance areas (The Atlantic Private Maintenance Agreement (APMA) and Asia Pacific Marine Maintenance Service Agreement) covering all the non-Arctic sections of the planned cable routes. While ACMA includes sea areas between eastern Greenland and Svalbard, and APMA covers even the Baffin Bay area, sea areas north of Canada and Alaska, as well as the Central Arctic Ocean, are not included in maps describing the areas covered by different agreements. However, the recent cable repairs conducted by Quintillion north of Alaska have demonstrated the capability of service providers to carry out demanding projects in challenging environments. The cost of individual repairs is not publicly known, but the owners are reportedly paying between $600,000 and $3m per cable, depending on the extent of the disruption. Arguments suggesting that the highest bidders (likely to be large technology companies) may be prioritized in case multiple maintenance requests are made simultaneously are also relevant from the perspective of the planned ownership structure of the trans-Arctic cables (Tomaz and Voo 2024).

While the decisions made by individual companies or their consortiums are understandable, they have unfortunately created the problem of overconcentration and lack of diversity. To overcome the submarine cable industry's reluctance or inability to develop solutions that could address the problems, while also accounting for geopolitical tensions and national strategic interests, possibilities for public-private partnerships should be considered. This study contributes to these considerations and to informed decision-making regarding trans-Arctic cables.

3. Analysis

A short review of past and ongoing trans-Arctic cable projects

The idea of trans-Arctic submarine fiber-optic cable is not new. **The Russian Optical Trans-Arctic Submarine Cable System (ROTACS)** project was launched in the early 2000s and led by a company called Polarnet. The project attempted to connect London and Tokyo through the Northeast Passage. It received both financial support and necessary approvals from the Russian authorities, but eventually failed. This was at least partly because of the withdrawal of the American partner company and the sanctions that Western countries imposed on Russia after the annexation of Crimea in 2014. Soon after ROTACS had failed, a new trans-Arctic project was initiated in Finland. Following the studies commissioned by the Prime Minister's Office, the Confederation of Finnish Industries, and the Ministry of Transport and Communication, and the international high-level bureaucratic meeting, the mainly Finnish state owned Cinia Ltd., began to lead t**he Arctic Connect** project. Although Chinese authorities and companies such as China Telecom Corporation were also taking part in early discussions, Japan was quickly recognized as the key East Asian partner (Delaunay 2014; Saunavaara 2018).

This project envisioned a cable system from northern Europe (landing in Kirkenes, Norway) to Japan, including fiber pairs landing is selected destinations in the Russian Arctic and Far East and direct connection without any landings in Russia. The project took an important step forward when a memorandum of understanding between Cinia and its Russian partner MegaFon was announced in 2019. While Cinia and Megafon oversaw project that conducted the first seabed survey through the Northeast Passage and secured NORDUnet, a Nordic Research and Educational Network, as their first anchor customer, it was also supported by the international Cinia Alliance involving several companies from Japan. However, in May 2021, MegaFon unilaterally decided to freeze the project. Although the reasons behind Megafon's sudden withdrawal are only known by those participating decision-making within the company, it can be expected that the announcement of the Russian state-controlled and funded project called Polar Express in April 2021, played a major role behind this decision. Immediately after the announcement there was also a rumor in Russian media (spreading also to some Western media) according to which Megafon's decision would have been based on inactivity of Sojitz Corporation, which was leading the group of Japanese companies involved in the Cinia Alliance (Saunavaara, 2021). While Cinia quickly denied these rumors, it did not change the fact that the Japanese companies who had invested in the Arctic Connect lost their investments (Saunavaara 2022; Saunavaara and Salminen 2023).

The new Russian project called **Polar Express** envisioned a new communication cable from Teriberka near Murmansk to Vladivostok with several landings in the Russian Arctic and Far East. It thus introduced a plan that was almost identical with the Arctic Connect's part including landings in Russia (Middleton and Rønning, 2022; Saunavaara, 2022). Although this project was to be exclusively financed by the Russian state, Russian actors expressed their interest in developing international cable interconnections. The Russian state-owned cable infrastructure was considered as an unattractive option to European, American and Japanese businesses already in the 2021, and the possibilities for such a cooperation slumped after the Russian invasion of Ukraine in February 2022.

The trans-Arctic submarine data cable through the Northwest Passage was first proposed by a Canadian company called **Arctic Fibre** at the beginning of the 2010s. Besides connecting Europe and Japan, the new system was also expected to improve connectivity to remote communities in Canada and Alaska. The Arctic Fibre was also discussed in Japan and Tomakomai (Hokkaido) was identified as a possible new landing site. However, the partial implementation of the project became possible only after the Alaska-based **Quintillion Subsea Holdings** acquired Arctic Fibre's assets. Quintillion managed to complete Phase 1 of the project and built a regional system along the coast of Alaska including both submarine and terrestrial cables. The company's early success did not last. The company's debts started to pile up in the spring of 2018 and Quintillion filed for bankruptcy protection. The company also faced allegations according to which it had misrepresented the status of its cable projects, misused investments funds, and engaged in improper accounting practices. In June 2019, the former chief executive officer (CEO) of Quintillion was sentenced to 60 months in prison for defrauding investors (United States Attorney's Office 2019).

Under the new leadership, Quintillion partnered with ATLAS Space Operations to construct the highest-latitude satellite ground station in the US. While the overall aim of connecting Europe, North America and Japan has remained, concrete steps in this direction have remained scarce. Quintillion announced in August 2022 that they have hired the Japan Director to oversee the process of connecting their cable system with Japan. However, no evidence of advancement has been found. In late March 2023, Quintillion signed an MOU CanArctic Inuit Networks Inc. to jointly build a subsea fiber optic cable from Happy Valley-Goose Bay, NL to Iqaluit, Nunavut. Soon after that, in April 2023, Quintillion was acquired by Washington, D.C.-based private investment firm Grain Management, LLC (Quintillion 2024). Meanwhile, Quintillion has suffered from submarine cables breaks both in June 2023 and April 2024 (Downing 2024).

While longer than the route through the Northeast Passage, the Northwest Passage route received new interest after the failure of the Arctic Connect project. In December 2021, Finnish Cinia and American Far North Digital announced a joint effort to build a the 14,000-kilometer-long cable system linking Japan and Europe through the Northwest Passage. ARTERIA Networks Corporation (now a subsidiary of the Japanese trading house Marubeni) formally joined to project in February 2022 and **Far North Fiber** Inc. was established in October 2022. Alcatel Submarine Networks was selected to build and install the submarine cable and equipment required, and NORDUnet has signed a Letter of Intent with the project to finance one of the fiber pairs (Far North Fiber, 2022).

The submarine cable route Digital Footprint AS proposed in its initiative called Borealis differed drastically from the earlier projects trying to connect northern Europe and Asia. The **Borealis project** envisioned a submarine fiber-optic cable crossing the Central Arctic Ocean rather than following the Northeast or the Northwest Passage. While proposing a route bringing forth technical challenges due to year-round sea ice, the Borealis project also promoted a SMART cable to be utilized in ocean and climate monitoring and disaster warning (Fouch 2018; The Joint Task Force for Smart Cables 2018). The Borealis project remained quite poorly known and at the level of concept planning. However, the idea re-appeared as a part of the process leading to NORDUnet's Vision 2030 (NORDUnet 2024). The name of the project promoting a SMART cable through the Central Arctic Ocean changed to Polar Connect. The project is currently developed by NORDUnet, the Swedish Polar Research Secretariat, and the Swedish Research Council – SUNET, which are also overseeing the North Pole Fiber project (22-EU-DIG-NPF) doing preparatory work for Polar Connect (NORDUnet 2024; North Pole Fiber 2024).

According to an informant, those in charge of Borealis were consulted at the planning of Polar Connect. Borealis was based on private funding, but the Polar Connect project has received support from the EU and seems to assume an implementation based on public-private partnership. While the project team has introduced possibilities related to SMART cables, and the planned installation process based on the utilization of a new Swedish icebreaker, in various international events, no information concerning the commercial actors involved in the project has been revealed. This has caused some astonishment in informal discussion among the Japanese stakeholders. Furthermore, the Swedish Government has not yet confirmed the order of the icebreaker that would presumably also have important cable repair capabilities.

Regulatory framework

The first international treaty governing submarine telegraph cables, the 1884 Convention for the Protection of Submarine Telegraph Cables, contained provisions relating to the breakage or injury of cables, as well as protection of cable ships engaged in laying and repair activities. These provisions, in turn, gave an impetus to the creation of national legislation. While the regulatory framework affecting submarine cables was altered through the adoption of the 1958 Geneva Conventions on the High Seas and the Continental Shelf, it is **the United Nations Convention on the Law of Sea (UNCLOS)** and its provisions on submarine cables that form the foundation for the current international legal regime. This framework concerns the following issues: surveying of cable routes, laying of cables, and the repair and maintenance of cables. It defines the rights and obligations of coastal and other states in situations where cable operations take place in territorial seas, maritime zones within the national jurisdiction of coastal states (Exclusive Economic Zone (EEZ) and the continental shelf), or in maritime zones beyond national jurisdiction. Furthermore, the national legislations may introduce regulations and procedures not required by the UNCLOS (Burnett, Davenport, and Beckman 2014; Shvets 2017; Davenport 2018; Shvets 2020).

The Bering Strait is an example of area where international law (UNCLOS and Polar Code etc.), bilateral agreements between the US and Russia (environmental protection and species conservation regimes) as well as the domestic laws and regulation need to be considered. The Strait lies within the territorial seas of the Russia and the US, and the remaining waters of the region are located within the EEZs of the two countries. As the Bering Strait is considered as an international strait based on the definition of UNCLOS, the specific legal regime of such straits is applicable. The US has not ratified UNCLOS, but considers that the Convention reflects customary international law (Berkman, Vylegzhanin and Young 2016). While the existing research focuses on the legal status of the Bering Strait before the Russian invasion of Ukraine, the war should not impact the laying of cables on the US territorial waters if Russia does not challenge the 1990 bilateral Agreement on Maritime Delimitation. The Russian Federation has not ratified this agreement but both states have respected the boundary line for more than 25 years.

The International Cable Protection Committee (ICPC), which acts as a forum for international cooperation and provides technical, legal, and environmental information about submarine cables, has had a consultative status with the United Nations since April 2018. The ICPC, however, does not have actual authority to govern or control the development of the submarine fiber-optic cable network (Rauscher 2010; Davenport 2018; ICPC 2018).

Besides international regulations, states have laws for telecommunications, which mandate their regulatory bodies for supervising the licensing and functioning of telecommunications infrastructures, including submarine cables. States may also have laws governing the operators' laying and maintaining of the cables on the continental shelf and laws that penalize intentional and negligent disturbances of submarine communication cables. In the case of Japan, Telecommunication Business Act is the governing legislation for the telecommunication operations (Ishii and Saunavaara 2024).

Benefits and opportunities of Arctic Connectivity

Despite differences in the proposed routes, the envisioned benefits are shared by all trans-Arctic submarine fiber-optic cable projects. The Arctic is seen as a shortcut that enables shorter cable connections and reduces network latency significantly when compared to the existing routes. Similarly, Arctic cables would increase the diversity and robustness of the global submarine cable network suffering from over-concentration. In this context, the significance of the first successful trans-Arctic cable must be emphasized. While a single cable system alone may not provide enough capacity to cause a major shift in intercontinental data flows, it can validate the long-discussed Arctic cable concept and pave the way for subsequent projects.

The economic benefits related to the trans-Arctic cables can be approached at least from four different perspectives. First, the companies in charge of the design and development of different projects are typically profit-seeking. The companies involved in the production and installation of submarine cables also follow regular business logic and sell their products and services at the price that secures reasonable profit margins. Second, the successful implementation of trans-Arctic submarine cable project(s) should provide long-term economic benefits to companies and organizations that invest in them. However, the investors involved will surely be aware of the relatively long payback time of the infrastructure and understand submarine cables as relatively low margin and low risk long-term investments. Third, the capacity buyers/users of the cable(s) seek direct or indirect economic benefits, which may be related to the costs of transmitting data, the competitive advantages gained through faster connections, or the risk reduction achieved by utilizing diverse cable routes.

Attention should also be paid to the positive economic impact on national and regional economies. According to the 2022 study by Copenhagen Economics, the trans-Arctic cables and Nordic-centered digital infrastructure is not only an attractive option for the EU, but also offers an additional source of growth for the Nordic region itself. The study argues that the location of submarine cables and data centers leads to substantial spillover effects to the regions in which they are placed and estimates that an Arctic cable to Japan could boost GDP in the Nordic region by more than EUR 1 billion annually if fully utilized (NORDUnet 2022). However, the second report published at the beginning of 2024 raised concern that the wider societal and economic benefits of the trans-Arctic submarine cables are often not fully factored into investment decisions. Therefore, neither the positive impacts on regional economy nor to European digital resiliency and autonomy receive the attention they deserve (Copenhagen Economics 2024). Although no comprehensive estimation and calculations concerning the possible economic impacts on regional economy have been made, similar kinds of favorable outcomes are also expected in Hokkaido, for example.

Arctic cables, geopolitics and security

Submarine fiber-optic cables' role as critical infrastructure is nowadays well understood. Therefore, the linkage between geopolitics and submarine cables as well as the importance of this infrastructure in securing EU's strategic digital autonomy is often emphasized. Besides recognizing the possibilities, alarmed voices has also been heard in connection to China's digital Arctic Silk Road initiative, for example (Delaunay & Laundriault 2020). The trans-Arctic submarine fiber-optic cables and other attempts to improve connectivity in the Arctic are highly relevant from the perspective of **human security of the people living in the Arctic**. Yet, discussion concerning possibilities related to e-learning, e-healthcare, and other aspects of human security make sense only if the local communities and telecommunications companies, who are the build the infrastructure around the planned landing stations in the Arctic, are included.

Traditional security concerns have always played a role in the development of submarine cable infrastructure, and they have been considered also in the context of Arctic projects. While the Arctic cable initiatives by the Russian military that appeared in international media in the springs of 2018 and 2019 (Saunavaara 2022), are extreme examples of this kind of connection, the security dimensions of the Arctic cables have also been identified and analyzed in Europe and the US. A report focusing on the Arctic Connect project and cybersecurity was published in 2019. The report concluded that submarine cables systems are very interesting destination for hackers, cyber attackers, terrorist and state actors; tapping fiber-optic cables to eavesdrop the information is a conscious threat; and sabotage would be simpler to perform than tapping, but the networks high degree of redundancy would limit the effects that attack against one cable system would have (Lehto et al. 2019).

In the US, Team Telecom designated the Quintillion network as a critical infrastructure for national security already before the company underwent a major re-organization following the fraud case. As a part of this process, many key people with background in the US military and national security were recruited to the company's new leadership team. When Quintillion and ATLAS Space Operations completed the construction of the satellite ground station in February 2021, it was described as a significant step forward in the quest to close a critical gap in US security capabilities in the Arctic. In their homepage (as of 17 November 2024), the company describes the Arctic as the site of a powerful trifecta between three world superpowers, Russia and China's increasing investments in the region as a strategic threat, broadband as the foundational infrastructure upon which any successful Arctic strategy must be built on, and Quintillion as an actor contributing to the American homeland security.

The recent recognition of submarine fiber-optic cables as critical infrastructure originates from various sources. **The submarine cable conflicts and tensions between the US and China**, which heated-up in the mid-2010s, impact all international cable industry-related developments. Given China's strict control over, and the government's close ties with telecommunications companies, the US has growing concerns (shared by many other countries) about Chinese companies' involvement in building, owning, or controlling subsea cable systems. The fears that China could spy on global internet traffic or intercept sensitive data has led to restrictions on certain Chinese companies, like Huawei. The US government has also blocked submarine fiber-optic cable projects (such as the Pacific Light Cable Network) involving Chinese state-owned companies and exerted influence over projects to ensure that Chinese companies do not gain control over international communication routes (Gross et al. 2023).

The role of Yemen's Houthi rebels in the submarine cable cuts in the Red Sea, one of the choke points in data traffic between Europe and Asia, has received significant attention since the spring of 2024. While these problems have been used as an argument on behalf of the trans-Arctic cables, which would increase network diversity, the northern waters have also witnessed several incidents where intentional damaging has been proven or speculated. **The Russian invasion of Ukraine in February 2022** and the explosion of the Nord Stream gas pipelines alarmed political decision makers and the public about the importance and vulnerability of subsea infrastructures. Succeeding the Nord Stream case, new attention was paid to Russian vessels' suspicious activities near submarine fiber-optic cables and the incidents that had occurred in northern Norway in April 2021 and January 2022. The Baltic Connector incident, which occurred in October 2023, raised further questions concerning the security of submarine infrastructure and intentionality behind the accident caused by a container ship dragging its anchor and damaging data cable between Sweden and Estonia and a gas pipeline between Finland and Estonia.

Another incident happened on 17-18 November 2024 when submarine cables connecting Finland with northern Germany and Sweden with Lithuania were suddenly disrupted. While these cables intersect, the damages were at separate points. As natural explanations were ruled out, external force originating from human activity was quickly recognized as the cause of the cable break. International investigators identified a Chinese-registered vessel named Yi Peng 3, traveling from Russia to Egypt, as the main suspect. The cable has been repaired, but authorities around Europe are assessing potential responses to increased hybrid acts of warfare (Moss 2024; Cinia 2024). The most recent disruption to submarine cables in the Baltic Sea happened on 26 December 2024. This time the Finnish authorities boarded the Eagle S oil tanker in Finnish waters and seized the vessel that damaged the Finnish-Estonian power line and four submarine telecommunications cables by dragging its anchor across the seabed. The tanker that was sailing from St. Petersburg to Egypt and belongs to Russia's "shadow fleet," is registered in the Cook Islands and owned by United Arab Emirates-based company (Reuters 2025).

The recognition of submarine fiber-optic cables as critical infrastructure has recently resulted in new reports, studies, and initiatives focused on analyzing or strengthening the physical and cyber security of these cables (Besch & Brown 2024). NATO decided in February 2024 to launch the Critical Undersea Infrastructure Network. The first meeting of the group bringing together experts from across the Alliance was held in May 2024, when the new Maritime Centre for Security of Critical Undersea Infrastructure within NATO's Maritime Command (MARCOM) in Northwood, UK, was established. Underlining Russia's intensifying hybrid operations, participants discussed ways to enhance information-sharing and situational awareness, as well as ways to deter and defend against threats to undersea infrastructure (NATO 2023; NATO 2024).

The European Union Agency for Cybersecurity (ENISA 2023) studied the importance of, and risks related to submarine cables. The identified actions included, among other things, the need to clarify the responsibilities and mandate of national authorities for the protection and security of subsea cables and the landing stations, improve monitoring of subsea cables, ensure that cable landing stations and the subsea cable network management systems are protected from physical and cybersecurity threats, and promote diversification of subsea cable routes and diversification of cable types along the same route. The International Telecommunication Union (ITU) announced at the end of September 2024 that it is setting up an International Advisory Body for Submarine Cable Resilience with an aim to promote dialogue and collaboration on potential ways and means to improve resilience of this critical infrastructure that powers global communications and the digital economy (ITU 2024). Meanwhile, The Federal Communications Commission (the US) announced on November 21, 2024, that it will begin a comprehensive review and update of licensing rules for submarine cables.

The FCC noted that since the agency's last review in 2001, the technology, economics, and national security environments surrounding these systems have greatly changed. While seeking comments on how best to improve and streamline the submarine cable rules to facilitate efficient deployment of submarine cables while ensuring the security, resilience, and protection of this critical infrastructure, FCC is interested in streamlining the security review of license applications involving numerous federal actors through the Committee for the Assessment of Foreign Participation in the United States Telecommunications Services Sector (or Team Telecom) and the State Department. A three-year periodic reporting requirement for cable landing licenses, shortening the current 25-year license term, and new rules requiring, for the first time, companies with international telecommunications authorizations to file renewal applications with the FCC, have been proposed. Finally, the need for prohibiting communications equipment and services deemed to pose an unacceptable risk to national security is emphasized. Besides prohibiting the use of public funds to purchase designated equipment or services, a launch of the Secure and Trusted Communications Networks Reimbursement Program to reimburse providers for costs incurred to remove, replace, and dispose of such equipment and services already been installed in U.S. networks, is noticed (FCC 2024a).

Studies concerning hybrid threats and subsea fiber-optic cables have also been conducted in the Arctic context. Alexander Dalziel's report focusing on Arctic Canada identifies Russia as the main concern for Canada despite People's Republic of China is also identified as a potential hybrid threat actor. The document concludes that it is very difficult to determine whether human-caused damage to critical subsea infrastructure is accidental or intentional, as case studies from the Nordic region show, and calls for improved situational awareness and response plans to reduces the risks (Dalziel 2024) The problems related to the current (aged) regulatory framework have also become visible during the recent incidents where suspicions concerning intentional cable damage have come up at the Baltic Sea. After the most recent incident, a Finnish expert of international maritime law argued that the existing regulatory framework does not recognize or take into consideration a situation where a state-actor is sabotaging a submarine cable. Therefore, the existing maritime law does not provide tools or possibility for disciplinary activities (Löytömäki 2024).

Attention paid to security concerns has impacted debate around SMART cables. The possible dual use of SMART cables has been considered as a factor hindering the development of collaboration between industry and academia. It has been assumed that possible dual use would complicate the permitting process and military authorities' negative attitude toward this kind of infrastructure has been speculated. **During recent years, however, submarine cables' capability to observe their surroundings has also been described as a tool to increase the security of the infrastructure.** Yet, a significant difference in the level of interest and commitment can be observed when questions concerning SMART cables and security are approached from the perspective of Japan and the EU.

Japan is highly prone to natural hazards ranging from earthquakes and tsunamis to volcanic eruptions and typhoons. It is thus not surprising that the general level of disaster preparedness is high and natural hazards' potential impact on the submarine fiber-optic cable infrastructure is well understood and integrated in relevant policies (as manifested by the ongoing attempt to decentralize digital infrastructure). Risks related to attacks against submarine fiber-optic cables have been occasionally discussed in Japanese media (Yamazaki 2022) and vulnerability regarding undersea cables has also been raised by politicians representing the ruling Liberal Democratic Party (Liberal Democratic Party 2021). Meanwhile, the recent incident where a ship owned by a Hong Kong-based company but registered both in Cameroon and Tanzania is being investigated for damaging a submarine fiber optic cable in waters off the northeastern coast of Taiwan could raise awareness regarding intentional damage of submarine cables in Japan as well (The Asahi Shimbun 2025).

Submarine cables' role to collect security-relevant information has hardly been mentioned in discussions among Japanese stakeholders involved in the trans-Arctic projects. Meanwhile, the EU has introduced the NIS2 Directive emphasizing submarine cables vulnerability to cyberattacks, natural disasters, and geopolitical sabotage. According to a recent article in one of the leading cable industry publications, the new directive obliges submarine cable operators to adopt advanced cyber risk management strategies to protect against physical and digital attacks, calls for infrastructures to go beyond basic measures, and requires the integration of new technologies, such as SMART Cables to create dynamic, "cyber-aware" ecosystems that enhance real-time incident and digital threat detection and response. In the new vocabulary introduced by the article, dual use has turned into multifunctionality and cables contribution to environmental monitoring seem to appear as subordinate function to SMART technologies capability to protect the infrastructure itself (Amaro 2024).

If the trans-Arctic submarine fiber-optic cables are utilized to collect environmental or other types of data, questions concerning data ownership, management and accessibility will emerge. Negotiations concerning these kinds of issues may be time-consuming and troublesome due to the presumably large number of stakeholders involved. Besides the national and regional governments and private companies involved in the cable project, interested parties might also include end-users of the data ranging from academic researchers to actors representing national security concerns. Furthermore, the fast accumulation of data would also necessitate decisions concerning the data repository.

Arctic cables and global cable topology

Although the current projects assume Japan as the East Asian end of the Arctic cable, impacts beyond Japan are also expected. When European Commission President H.E. Ursula von der Leyen visited Philippines in July 2023, she referred to plan to connect the EU via the Arctic to Japan, and proposed that the cable could be extended to the Philippines and Southeast Asia (European Comissions 2023). Similar kind of ideas have also been proposed among the Japanese experts, who have emphasized the importance of Guam, for example. Thus, discussion on Arctic cables is connected to wider debate concerning the submarine cable network topology in the Asia-Pacific. While the statement made by

President von der Leyen mentioned the Philippines as a potential future digital hub in the region, Japanese experts have envisioned this position to Japan (Murai 2022; Yanagawa 2022).

The redesigning of the network topology is connected to other ongoing and planned cable projects. Google alone announced a $1 billion investment in digital connectivity to Japan in April 2024. The investment includes both the expansion of the Pacific Connect initiative and building of two new subsea cables, Proa and Taihei, in collaboration with international partners such as KDDI and Arteria Networks from Japan. Both companies have collaborated with Google already in the past. The Proa subsea cable from NEC Corporation will connect Japan, the Commonwealth of the Northern Mariana Islands (CNMI), and Guam. Furthermore, the NEC cable system Taiwan-Philippines-US (TPU) will be extended to the CNMI, and these two projects will together establish a new route between the continental US and Japan (Shima in Mie Prefecture). Taihei, another NEC cable, will connect Japan to Hawaii and create connection between the continental US and Japan (Takahagi in Ibaraki Prefecture) together with the Tabua cable that will be extended to Hawaii (Quigley 2024).

JUNO, updated ready-for-service data in March 2025, is another new submarine cable system connecting Japan (Minamiboso in Chiba Prefecture and Shima) and the US. JUNO will provide a system capacity of 360Tbps, which makes it larger than any of the existing trans-pacific cable systems. JUNO will be owned and operated by Seren Juno Network Co., which was established in July 2022 as a joint venture of NTT Japan Corporation, Mitsui & Co., PC Landing Corporation, and JA Mitsui Leasing. NEC is the cable system supplier and oversees the building of JUNO (Submarine Cable Networks 2024; TeleGeography 2024).

Environmental/ecological concerns and SMART cables

Besides shaping the digital environment, submarine cables are present and impact the physical environment they are laid. Even if the fiber-optic cables and cable operations have a minor negative impact on the marine environment, the interactions between the environment and submarine cables are inevitable. The most significant direct impacts happen when submarine cables are buried in shallow waters. While the cable burial involving mechanical ploughing and high-pressure water injection disturbs the benthic environment, it differs significantly from bottom trawling. The fishing activities are repetitive and affect wide areas, but cable burial is a one-off operation affecting only the designated narrow cable route. The Arctic environment offers also unique challenges related to the thawing (subsea) permafrost. The installation of terrestrial cable has already accelerated the melting process in Alaska through the removal of the insulting topsoil and vegetation. However, knowledge concerning the relationship between subsea permafrost and fiber-optic cable burial in relatively shallow waters is still limited (Davenport 2018; Grove 2018; Saunavaara, Kylli and Salminen 2021).

Though the international standards for environmental regulations have tightened, they should not cause problems for well-established companies with experience in international cable projects. Apart from the Hokkaido/Tomakomai cable landing, the trans-Arctic cables are expected to utilize already existing landing sites in Japan. The negotiations between local authorities, cable industry, and other stakeholders have been ongoing in Tomakomai already some years. While the Japanese end of the cable systems should thus not offer unforeseen difficulties, the Arctic cables will face the same challenges with sea-ice and icebergs as those witnessed by submarine telephone and telegraph cables during the past 150 years. Technologies and materials have developed but the recent challenges faced by Quintillion in Alaska highlight the importance of peculiar Artic environmental features even today. While sea-ice can threaten the submarine infrastructure and hinder attempts to correct damaged cables, ice can also be regarded as an asset. As the sea-ice prevents human activities, it will also decrease the risk of man-made damages. In general, the fiber-optic cables fit well into the Arctic environment because they can function flawlessly even when exposed to extreme temperature (Bannerman 2018; Saunavaara, Kylli and Salminen 2021).

Organisms encrusted on recovered submarine communication cables have increased knowledge of the deep ocean marine biota. This kind of ad hoc collection of data has recently been replaced by systematic environmental observation and monitoring based on SMART cable initiatives. According to the mainstream definition, the purpose of SMART cables is to support climate and ocean observation, sea level monitoring, observations of Earth structure, and tsunami and earthquake early warning and disaster risk reduction, including hazard quantification. If one deploys oceanographic sensors, designed to measure temperature, salinity, ocean circulation, sea level rise and so forth, on undersea telecommunication cables, extensive, longitudinal, real-time data can be obtained from sites in the deep ocean and continental margins. If relying on other types of research infrastructures, data collection from these sites can be extremely difficult and expensive. While repeaters capable of regenerating fiber-optic signals every 50–100 km are often envisioned as the part of the cable system which could host these sensors, the fiber itself can be used as the sensing element as well.

The Distributed Acoustic Sensing (DAS) technology uses fiber-optic cables to detect and measure acoustic signals along the length of the cable. Therefore, DAS enables continuous monitoring over large areas. The DAS approach is based on a laser pulse that is sent down the fiber-optic cable. As the pulse travels through the cable, it interacts with the fiber material. When the pulse encounters vibrations or acoustic signals, it causes small changes in the light that is reflected back to the sensor. These changes can be analyzed to determine the nature of the disturbance (Marra et al., 2018; Starosielski, 2015; Howe et al, 2019; Webster & Dawe, 2019; ASN 2024).

Cooperation between the cable industry and the scientific community could benefit both parties. The latter could cover a portion of the total cost of the cable system and purchase the capacity needed to transmit the observation data to ground-based research institutes, but the financial burden carried by the academic community would be significantly less than the price of the monitoring system used only for scientific purposes. The suggested industry-academia cooperation is particularly appealing in the Arctic as the Arctic Ocean is sparsely researched in comparison to other marine areas around the world, and it is a very challenging environment for the development and maintenance of research infrastructure (Saunavaara, Kylli and Salminen 2021; Saunavaara and Salminen 2023). The possibilities of SMART cables were mentioned in the case of Arctic Connect and they are emphasized in the Far North Fiber project. Meanwhile, the projects envisioning the Central Arctic Ocean route, Borealis and Polar Connect, have been based on the SMART cable approach. Quintillion has also expressed its tentative interest in the utilization of DAS technology when planning the installation of another 1,100 miles of line down Alaska's Bering Strait region by 2027 (Hentz 2024).

The idea behind SMART cables is not new and they have been studied under the auspices of the International Telecommunications Union (ITU), World Meteorological Organization (WMO), UNESCO, and the International Oceanographic Commission (IOC) Joint Task Force established in 2012. Despite the identified benefits, the advance of SMART cable projects has remained relatively slow. Reliability is one of the most important features of the submarine fiber-optic cable infrastructure, which is expected to function for 25 years. Therefore, cable system developers and owners are reluctant to accept new or unproven modifications to existing designs without some substantial benefit in exchange. One of the key challenges has been to ensure that the sensors have a minimal/no impact on the functioning of the cable that is hosting them. As the sensor functions are unlikely to achieve the same level of reliability as the rest of the cable infrastructure, the cable system must be designed in a way that the telecommunications capabilities continue to function even if sensors fail.

Technological development has, however, been rapid in recent years. Succeeding the pioneering projects, such as InSEA SMART Cable: wet demonstrator project (Italy) and SMART TAMTAM (Vanuatu-New Caledonia), new SMART cable initiatives have merged in different parts of the world. Nowadays, the CAM submarine cable system that connects the Mainland Portugal to the Azores and Madeira, is considered one of the most sophisticated SMART cable systems.

Japan has been involved in international collaboration concerning SMART cables and gained experience through projects like the Dense Ocean-floor Network System for Earthquakes and Tsunamis (DONET) and S-Net, for example. DONET, equipped with seismometers and sensors to measure pressure from the water above, has been developed by JAMSTEC in collaboration with the

Japan Meteorological Agency and the National Research Institute for Earthquake Science and Disaster Prevention (NIED), which receive the collected data in real-time via the dedicated line (JAMSTEC 2011). The S-net consists of 150 seafloor observatories, equipped with highly sensitive pressure gauges and seismometers, and connected with submarine optical cables with the total length of 5,500 kilometres. The S-net covers the focal region of the 2011 Tohoku Earthquake. These cable systems, as well as the planned Nankai Trough Seafloor Observation Network for Earthquakes and Tsunamis (N-net), are primarily designed for seismic and oceanographic observation (NIED 2024).

Possible use cases and potential customer analysis

The companies developing different trans-Arctic projects have introduced potential user and customer groups for their planned cable systems. Various studies and reports (such as those prepared or commissioned by NORDUnet) and academic publications and presentations have further strengthened expectations concerning the potential use cases. However, none of the projects have been completed and NORDUnet still remains the only entity, which has publicly expressed its intention to purchase capacity. Therefore, one can only speculate and describe actors whose assumed interests in the trans-Arctic cables are based either on their role in other submarine fiber-optic cable projects or on the advantages they might gain if Arctic cables are implemented.

International consortia formed by **telecommunications operators and carriers** oversaw the large-scale submarine cable projects for a long time. They still own and operate most cable systems and the national backbone providers have traditionally been also the customers buying the submarine cable capacity. If the Russian state-controlled projects are forgotten, international consortium has also been the proposed model for trans-Arctic cable projects. In other words, the shift toward single ownership that has reshaped the global submarine cable markets since the second half of the 2010s has not impacted the Arctic projects. When the benefits of the trans-Arctic cable projects are introduced to telecommunications operators and carriers, both the **arguments referring to lower network latency and increased network diversity are relevant**.

It is still important to recognize that much of the recent growth in the number of installed cables and total capacity has been spurred on by **companies such as Facebook/Meta, Google, Microsoft, and Amazon/AWS**. Rather than remaining as capacity purchasers and important customers of traditional telecom companies, the American OTTs first joined international partnerships as co-owners, and then began to build and own international cables (Capacity Media 2018; Copenhagen Economics 2024; NORDUnet 2024). A recent analysis pointed out that while these content providers had invested in 20 subsea cables in 2017, the number has already increased in 59. Google has been the most active and invested in 33 subsea cables (17 owned and 16 part-owners), followed by Meta (16 majority part ownership), Microsoft (interests in 6 cables), and Amazon (interests in 4 cables) (Verdict 2024). Furthermore, META announced at the beginning of December 2024 that it plans to invest $10 billion to a 40,000-kilometer-long submarine cable project connecting the east coast of the US to South Africa, India, Australia, and the west coast of the US. The planned cable would be the first to be solely owned and used by META. The rationale behind the selected cable route is similar to that of the trans-Arctic cables. The benefit of these routes is their ability to avoid high-risk geopolitical regions such as the Red Sea, South China Sea, and Straits of Malacca (Sweeting 2024). As the service portfolio of the GAFAM companies is large, it is difficult to summarize their connectivity needs. However, the trans-Arctic cables' **ability to connect their data center campuses in different parts of the Northern Hemisphere can be used as a strong argument in favour of Arctic connectivity**.

While the ownership dynamics within the cable industry has changed, the interdependence between the submarine cable industry and the rapidly growing **data center industry** has increased**.** The landing stations have for long been identified as locations attracting new data center investments in the region. Menawhile, the location of hyperscalers and significant data center clusters can also have a steering effect on cable routes and landings. The dependency between these two pillars of the digital infrastructure has also been emphasized in the case of the trans-Arctic projects. The northward shift of data center industry has already happened both in Europe and Japan. The fact that **trans-Arctic cables would substantially improve international connectivity in many northern locations having other relevant assets** can be highlighted when Arctic connectivity initiatives are advocated to data center industry stakeholders.

Whereas the large-scale content providers and data center industry represent markets driven by large capacity needs, **financial sector** is a latency dependent market segment with readiness to pay for the milliseconds saved through the shorter distance. The actors involved in the high-frequency trading have been mentioned among the potential user of the trans-Arctic cables, but it is uncertain how big the capacity needs would be, and whether the actors involved would purchase or lease fiber pairs or rely on spectrum-sharing solutions. In any case, **Arctic routes' capability to offer the fastest connections between Europe and Japan should be emphasized** when promoting Arctic connectivity initiatives to this customer group.

The internet, as we know it today, owes much of its origin, evolution, and expansion to scientific research and collaborations. The development of the internet began from the Advanced Research Projects Agency Network (ARPANET) developed in late 1960 onwards. Approximately two decades later, in 1989, the World Wide Web (WWW) was proposed to facilitate the sharing of scientific research across institutions globally. More recently, the growth of big data in scientific research requiring massive computational resources and collaboration, as well as the utilization of machine learning and AI have further underlined the importance of data sharing capacity. As the demand for data intensive research grows, the influence of **the Research and Education Networks (REN)** is expanding**.** Submarine cables provide the necessary high-capacity and long-distance connections that enable global collaboration and data sharing. The active role played by NORDUnet, managing and operating a regional network and connecting the Nordic countries to other international research networks, is a prime example of REN's capabilities. The government-backed RENs also offer a **possibility for public authorities to be involved in and support submarine cable projects they consider strategically important**. Initiatives such as the **HANAMI** (HPC AlliaNce for Applications and supercoMputing Innovation) project, bringing together research teams representing excellence in High-Performance Computing from both Europe and Japan, can also be showcased when arguing on behalf of the new Arctic routes among European and Japanese RENs.

In general, the envisioned users of the trans-Arctic cables have remained the same although the projects and route options have changed. However, the increasing attention paid to SMART cable initiatives and security aspects seem reflect the recent tendency to emphasize the need for collaboration between private and public authors. Yet, this kind approach is also echoing older projects like Arctic Fibre that assumed a significant public funding especially from the Government of Canada (Starosielski 2015, Bennett 2016). When lobbying the Arctic SMART cables, attention should be paid to different stakeholder that need to be convinced. While the Arctic research communities should be approached with a message underlining **the benefits of the SMART technologies when compared to other observation and data collection methods**, potential funding agencies and regulatory authorities are surely expecting proofs concerning cost-efficiency and technological feasibility, for example. If the Arctic connectivity projects are to be promoted among military authorities and other national security concerns, one should underline **the geopolitical significance of the Arctic and the modern warfare and intelligence gatherings' dependency on well-functioning and robust digital infrastructure**.

Identification and analysis of key stakeholders in Japan

A great variety of Japanese actors have been involved in one or several trans-Arctic cable projects. It is unclear who were the Japanese partners interested in the ROTACS project, but discussions concerning Arctic Fibre already included key figures such as Professor Jun Murai, often called the Father of the Internet in Japan, and Tsuyoshi Yamamoto, who has various roles and responsibilities outside the academia. The Gurōbaru Kuraudonettowaaku Kenkyūkai (known in English as Cloud

Networks), led by the later, brought together industry, academia and regional government, to prepare a policy proposal in 2014 that analyzed and described the possibilities the trans-Arctic cable could offer to Hokkaido and Japan (Cloud Networks 2014). The Arctic Connect project was joined by a group of Japanese led by Sojitz Corporation, a multi-national trading and investment company, and comprising also, Atago Corporation, Crypton Future Media, Hokkaido Electric Power Company, Optage and Sakura Internet (Datacenter Forum 2020). Many of these companies are based on have strong ties with Hokkaido.

Hokkaido Nutopia Data Center Study Group (HNDC 2024; composition of the Steering Committee: Appendix 2) forms an important platform for the exchange of information and opinions among the Japanese stakeholders representing industry, academic researchers and various levels of government. Sojitz, the leader of the Japanese consortium in the Arctic Connect, was not directly involved in the Study Group, but Sakura Internet (active in the HNDC Study Group) is one of its major group companies. Meanwhile, the representatives of Arteria, involved in the Far North Fiber, have told that they became aware of and interested in the Arctic cables through the Study Group. Other potentially relevant industry associations include, for example, the Japan Data Center Council (led by many of the key personnel also involved in the HNDC Study Group) and the Telecommunications Carriers Association. The Communications and Information Network Association of Japan (CIAJ) promotes the further use and advancement of information and communications technologies. CIAJ's members include communication network and equipment vendors, telecom carriers, service providers and user companies. It presents policy proposals and advocates industry views on government policies (CIAJ 2024). According to informal discussion, CIAJ is also involved in discussions concerning the decentralization of the digital infrastructure in Japan.

The Research and Educational Networks (REN) are expected to play an important role in the development of the trans-Arctic cable projects. In Japan, **the National Institute of Informatics (NII) plays an important role undertaking diverse services, including the development and operation of the Science Information NETwork (SINET)** connecting academic and research institutions and high-performance computing resources across Japan with a nationwide 400Gbps network. With network connection points across Japan, SINET supports community-building among researchers encourages wide distribution of scientific information. SINET is also interconnected with many research networks overseas, including Internet2 in the US (200Gbps) and GÉANT in Europe (400Gbps Japan-Amsterdam), and the Asia Pacific Advanced Network (APAN, 100Gbps connections to both Singapore and Guam). In April 2022, NII commenced full-scale operation of SINET6, an upgrade of SINET5, the previous version of its scientific information infrastructure (SINET 2024).

The WIDE Project is another actor at the interface of academic, industry, and government. Since its establishment in 1988, the WIDE project has led the Internet development in Japan and contributed to research, education, operation, and deployment of computing and communication technologies. The WIDE Project also collaborates globally with universities and research institutes to develop and operate RENs (WIDE 2024). While the WIDE project has traditionally been strongly committed to the Asia Pacific region, its leaders Professor Jun Murai and Professor Hirosi Esaki have played a visible role in Japanese discussion concerning the trans-Arctic cables. Besides the WIDE project, they also hold influential positions in Japan's Digital Agency and the Japan Data Center Council, for example.

Within the Japanese Government, the previously mentioned MIC, METI, and Digital Agency are the key actors involved in the development of international submarine fiber-optic cables. Hokkaido Government can be identified as the most active and relevant player in the Arctic connectivity-related matters among the regional authorities. **Hokkaido's interest in trans-Arctic cable projects is based on an assumption that improved international connectivity, achieved if the Arctic cables land in the northernmost island of Japan, would help to attract new data center investments.** The Hokkaido Government has been engaged in active exchange of opinions and information especially with the representative of Cinia for years. The Hokkaido Government has helped to organize various international and domestic events concerning Arctic data cables (such as the Arctic Economic Council's 3rd Top of the World Arctic Broadband Summit in 2018) and it has promoted the trans-Arctic cable projects often in close collaboration with the HNDC Study Group. Although the leaders of the prefectural government have directly met with the representatives of private companies involved in the Arctic cable projects, Nao Yanagawa from a company called Flower Communications has often acted as an adviser, middleman, and the representative of Hokkaido prefectural and local governments in negotiations with foreign parties.

Besides the advice provided by Yanagawa, the Hokkaido Government has nominated Jun Murai and Hiroshi Esaki, who act as the chairperson and expert at the Japanese Government's Expert Group on the Development of Digital Infrastructures, as advisers. When Professor Murai was appointed in July 2021, he was expected to help Hokkaido to realize a vibrant "Hokkaido Society 5.0" and to accelerate digital initiatives in the region. In his inaugural speech Professor Murai emphasized that Hokkaido has the potential to become a leading digital hub in Japan by leveraging its cool climate, proximity to Europe and the US, and abundant renewable energy resources (Hokkaido Government 2021). Professor Esaki was appointed as an advisor on promoting the use of renewable energy in Hokkaido in April 2023 (HNDC 2023). While Hokkaido Government has so far taken concrete steps (such as subsidies programs) in matters concerning the data center industry, there are unconfirmed rumours suggesting that the prefectural government is considering its possibility to be more directly involved in the promotion of the trans-Arctic cable initiatives.

Meanwhile, it can be noticed that **the three Japanese companies most experienced and actively involved in international submarine cable projects, NEC (Nippon Electric Company), NTT (Nippon Telegraph and Telephone Corporation) and KDDI, have not played a significant role in any Arctic cable projects.** The only exception might be NEC's early interest in the Central Arctic Ocean route. According to an unconfirmed information, NEC provided funding to the Borealis project that did not progress further than a desktop study. However, this happened at the time when cable companies were actively searching for new projects. Currently, many of them have full order books through the next few years.

NEC Corporation is known for its wide range of products and services in the fields of information technology, electronics, and telecommunications. NEC is also one of the world's leading suppliers of submarine cables and related infrastructure (together with Alcatel Submarine Networks (ASN, France), Subcom (the US) and HMN Technologies (formerly called Huawei Marine Networks, China). Since being involved in the submarine cable projects in the 1960s, NEC is globally recognized as an expert in the design, manufacture, and installation of high-performance submarine cable systems.

NTT is one of Japan's largest telecommunications companies and plays a crucial role in global communications. The company is involved in several large-scale submarine cable projects such as Asia-Pacific Gateway (APG, connecting Japan to countries in the Asia-Pacific region, such as China, South Korea, Malaysia, and Thailand), Jupiter (linking Japan to the US) and Asia Submarine-cable Express (ASE, connecting Japan, the Philippines, Hong Kong, and Singapore). NTT has also made significant investments in data centers across Europe. NTT's Global Data Centers division announced in February 2024 that it will develop and operate a 84 MW data center campus in the Paris market. This investments completed NTT's footprint in the FLAP Tier 1 markets in Europe as the company was already present in Frankfurt, London and Amsterdam (Jackson 2024). Meanwhile, the NTT WE Marine is involved in submarine fiber-optic cable design, laying and maintenance business (NTT World Engineering Marine Corporation 2025).

KDDI Corporation was formed through the merger of DDI (Domestic Data Interexchange), KDD (Kokusai Denshin Denwa), and IDO (International Digital Operations) in 2000. The company provides a wide range services including mobile communications, broadband internet, and fixed-line services. While KDDI is one of Japan's largest mobile network operators, it offers also enterprise solutions, cloud computing, and data center services. KDDI has partnered with other global telecommunications providers in consortiums to develop and maintain submarine cables (such as FASTER) that connect Japan with the rest of the world. KDDI also has capabilities related to cable installation and repair through KDDI Cableships & Subsea Engineering Inc. (KCS 2025). The company is also strongly present at the traditional centers of the European data center markets, for example, through Telehouse that is part of KDDI Corporation.

The potential role these companies could play in the Arctic projects has not been widely discussed, at least publicly. However, according to informal discussions with Japanese cable industry experts, the previous failures of several Arctic projects may have had a negative impact on NTT's and KDDI's interest in being involved in Arctic projects. As these companies are offering global services and strongly present both in Japan and Europe, new cable connections through the Arctic should offer them more versatile connectivity options. However, it can be pointed out that these companies' presence in the Nordic data center market is much smaller than in the traditional FLAP market. It is worth remembering that these companies have already invested in connections that at least partly compete with the proposed Arctic projects. However, if the expected rapid increase in data traffic and capacity demand happens, many companies may place their focus on attempts to gain their share of the growth rather than on worrying their capability to sell their existing capacity.

Other interesting Japanese companies include **Softbank and Rakuten**. SoftBank Group Corporation is a multinational conglomerate known for its investments in technology, telecommunications, and e-commerce, and it has partnered with NTT and a group of foreign partners in the Jupiter cable project. SoftBank announced its plan to build a 300 MW (with the first stage at 50 MW) data center in Tomakomai in the autumn of 2023. Company's President and CEO Junichi Miyakawa gave a speech at the Hokkaido University, Sapporo on 24 November 2023 (Hokkaido University 2023), where he discussed the need to improve Hokkaido's international connectivity and expressed Softbank's interests in Arctic cables. While negotiations between Arteria/Marubeni and SoftBank were mentioned in unofficial background discussions some time ago, SoftBank has not taken any formal steps to express its support or interest in joining the Arctic projects.

Rakuten is a Japanese e-commerce and technology company, which invest globally. Rakuten has established itself in European markets through a series of acquisitions and partnerships. Besides offering online shopping services, video-on-demand services and payment services in selected European markets, Rakuten has partnered with NTT Docomo and several big European telecom operators to advance the Open RAN technologies, for example (Lipscombe 2023; Rakuten 2024). Rakuten became directly involved in the submarine cable business in October 2021 by announcing a decision to join NTT Communications, KDDI and SoftBank in a project to build a high-capacity fiber-optic submarine cable to connect Hokkaido and Akita Prefecture. Rumours concerning Rakuten's plan to build a data center in Hokkaido have been spreading already many years. The fact that Jun Murai has a position on the Board of the company ensures that Rakuten has all the recent information concerning the trans-Arctic cable projects.

Identification and analysis of key stakeholders in North America

A detailed analysis of all the important stakeholders in the US and Canada may not be possible within the limits of the current study. Nevertheless, the potential role of the American big tech companies cannot be disregarded. Besides acting as drivers of ongoing submarine cable development, companies like Google, META and Amazon/AWS have many of their data centers located in several Nordic countries, Ireland, Japan and the West Coast of the US. Their interest in and willingness to invest in the northern Europe were further reconfirmed by Google's recent announcement to purchase large areas of land in the municipalities of Muhos and Kajaani for future expansions of its cloud and data center infrastructure in Finland (Finnish Government 2024). Kajaani, located in northern Finland, has often been mentioned in the context of trans-Arctic cables because it is home to LUMI supercomputer, which is part of the European Union's EuroHPC Joint Undertaking initiative and one of the most important pillars in HPC-related collaboration between the EU and Japan. The recent decision to select Kajaani as one of the hosting sites for the next EuroHPC supercomputer and AI factories will further strengthen this this position (LUMI 2024).

While informal exchange of information with key stakeholders have confirmed that discussions with the American big tech companies have taken place in the past, no formal steps to support the trans-Arctic projects have been taken by any of them. The representatives of the Polar Connect cable project outlined in an event organized on 7 October 2024 that they are not actively looking funding from the US even if some collaboration with the American authorities is needed for permissions. While this kind of categorial decision may be understandable and worth support from the perspective of European and Japanese digital strategic autonomy and sovereignty, it will also exclude a large part of the potential investors.

Among the North American public authorities, attention should be paid to the Federal Communications Commission (FCC). The FCC is an independent US government agency overseen by Congress, which regulates interstate and international communications by radio, television, wire, satellite and cable. According to a report released in early November 2024, the FCC has long recognized that rural areas of Alaska are some of the hardest and most costly to serve in the US, with many residents lacking access to high-quality and affordable broadband. The FCC established the 10-year Alaska Plan to support the maintenance and deployment of voice and broadband fixed and mobile services in 2016. While significant progress was made, many areas in Alaska remain unserved or underserved. The FCC recognizes the need for funding to maintain and operate the broadband networks built by the Universal Service Fund (USF) and the National Telecommunications and Information Administration's (NTIA)'s Broadband Equity, Access, and Deployment (BEAD) program. Therefore, the FCC has decided to establish the Alaska Connect Fund program to provide support to both mobile and fixed carriers receiving USF high-cost support in Alaska through 2034 (FCC 2024b).

The BEAD is part of the Infrastructure Investment and Jobs Act (IIJA) and allocates $42.45 billion to support broadband deployment across the US. The funds distributed through the program are meant for both "last mile" and "middle mile" infrastructure projects with a focus on expanding access in underserved areas. Besides the BEAD, IIJA included the Middle Mile Broadband Infrastructure Grant Program through which Quintillion, for example, has received $88.8 million infrastructure grant in June 2023 to build a multi-year subsea broadband project from Nome to Homer, Alaska (EIN Press wire 2023). These funds are managed and disbursed by the National Telecommunications and Information Administration (NTIA). NTIA is located within the Department of Commerce and is an agency principally responsible for advising the President on telecommunications and information policy issues (NTIA 2024).

Meanwhile, US Department of Agriculture (USDA) administers the USDA ReConnect Program, which is a grant and loan program with aim to expand broadband infrastructure in rural and underserved areas across the United States. In November 2024, Alaska Power & Telephone Company completed installation of the "SEALink South" submarine cable and landing sites, which had received a $29.3 million funding through the USDA ReConnect grant (Submarine Telecoms Forum 2024b; US Department of Agriculture 2024). The USDA Rural Development's ReConnect program also collaborates with the NTIA Tribal Broadband Connectivity Program as demonstrated their co-funding to the joint Bethel Native Corporation-GCI AIRRAQ Network Fiber project connecting 13 Yukon-Kuskokwim Delta communities (GCI 2024). As far as the subnational governments are considered, the State of Alaska is naturally to most important stakeholder in the US. Besides the different Federal Government programs, the readiness of the State to support the trans-Arctic cabkes, for the part they improve connectivity in Alaska, has been speculated.

Canada's connectivity strategy (Innovation, Science and Economic Development Canada (ISED) stated in 2019 that Canadians from all communities, both urban and rural, rely on access to reliable, affordable, high-speed Internet and mobile connectivity but recognizes the existence of a national connectivity gap. The new Strategy was described as a historic commitment to connect every Canadian to affordable, high-speed Internet no matter where they live. The objective is to be achieved through new investments and collaboration with partners. Building on the preceding Connect to Innovate program, the Canadian Government decided to invest $1.7 billion in new funding for broadband infrastructure. This included a new Universal Broadband Fund, supporting broadband projects through the $2 billion Rural and Northern Stream of the Investing in Canada Infrastructure Program, the Telecommunications Commission's (CRTC) $750 million Broadband Fund, support through the Canada Infrastructure Bank, and utilization of the Accelerated Investment Incentive program (ISED 2019). In addition to these programs, Canadian Government also has established a broader framework to address the needs of northern and Indigenous communities, including in terms of infrastructure development. There are also special programs focusing on indigenous communities (See: First Nations Technology Council 2024).

Some of the proposed projects, such as the initiative to build a submarine fiber-optic cable connecting Iqaluit (Canada) to Nuuk (Greenland) seem to be very relevant from the perspective of the Far North Fiber. Despite the Government of Canada announced new investments of over $151 million CAD to build a 1,700 kilometers cable through the Davies Straight already in 2019 (Shekar 2019), the project has faced delays. Meanwhile, there has also been a competing plan to connect Nunavut's capital to Goose Bay in Labrador where Bulk Infrastructure's cable from Norway is also landing (Lochead 2022). Despite the dealyes in the West, a major step forward in the Arctic Canada was taken when the Canada North Fibre Loop (CNFL) became operational in November 2024. The next step is to be taken when Sixty North Unity, a coalition of Indigenous organizations with a mission to enhance telecommunication services for Canada's northern communities, will acquire NorthwesTel, a subsidiary of BCE Inc, which provides telecommunications services in the northern regions of Canada. CNGL reaches the community of Inuvik, but there is also a separate fiber-optic cable between Inuvik Tuktoyaktuk, which the map on the homepage of the Far North Fiber identifies as one of the potential cable landings in Canadian Arctic (NorthwestTel 2024; Sixty North Unity 2024).

3 Conclusions and recommendations

It is plausible to argue that trans-Arctic submarine fiber-optic cables can help to solve many of the existing problems in the current global submarine cable network. These arguments are not new. Yet, all the previous projects attempting to develop such cables have failed, causing mistrust and doubt concerning the Arctic initiatives. To restore overall confidence in the viability and feasibility of the Arctic connectivity projects, **encouraging news concerning the existing projects is urgently needed**.

Plans describing scenarios where EU, Japan and North America are interconnected through various Arctic cables are useful for illustrating the great potential this of this region. However, given the current situation, **the prompt implementation of a good trans-Arctic cable project would be more important than the introduction of a great vision or future-oriented strategy**. To take the first concrete step toward the long-term goal, it is vitally important to lay the first trans-Arctic cable in the water even if it does not fulfill all the hopes and expectations. Therefore, **it is desirable that the EU demonstrates a readiness to compromise** on matters concerning the route and landings, number of fiber pairs, SMART features, for example, and promotes a similar approach also to its Japanese and other overseas partners.

The EU should also ensure that the Japanese Government and industry partners have a **clear understanding concerning the relationship between the different Arctic cable initiatives the EU is supporting**. When introducing realistic schedules for ongoing projects, the sequence of the Far North Fiber and Polar Connect projects should be clarified. As Polar Connect, which is more ambitious both technologically and in terms of its route, will require more preparation time, it will most likely succeed Far North Fiber. The successful implementation of the first project will likely increase international interest in the follow-up project. Given that several projects have already failed, it is undesirable to send a message that the EU supports several competing projects, which are simultaneously searching for Japanese industry partners and support from the Japanese Government.

To overcome the submarine cable industry's prejudice against new, untested routes, some form of **Public-Private Partnership is most likely needed to implement at least the first trans-Arctic submarine cable project**. It can be assumed that the need for public support may decrease after the successful implementation of the first project acting as proof of concept. Public financing and possibly also (partial) public ownership at the beginning of the life spam of the cable system could de-risk the project for private enterprises.

In the case of the **Far North Fiber project, it may be advisable to expand the shoulders and integrate new companies into the European and Japanese teams developing this project**. This could bring credibility, new competences and possibly also experience in the management of large international cable projects. The diversification of partners might also make it easier for the Japanese government to support the project that may currently appear as a project of one Japanese company and its relatively small overseas partners without proven track-record in Japan. As an important supporter of the Far North Fiber project, the EU can directly communicate its will and ambition to the project team, and make its views also known to the Japanese Government.

In the case of the Polar Connect project, it is essential to establish a clear project organization. Assuming that this project is not to be developed as a 100% publicly funded initiative, it is crucial to come up with a business plan and identify the key commercial actor(s) in charge of the project. These details should also be communicated to Japanese Government and potential industry partners as soon as possible. As an important supporter of the Polar Connect project, the EU can directly communicate its will and ambition to the project team.

The new capacity demand for data traffic between Japan and (northern) Europe would most likely make the trans-Arctic cable projects more attractive for private companies. **Whenever possible, the EU should encourage projects generating new data flows between EU and Japan**. From the perspective of the Arctic cable initiatives, Japanese actors' stronger integration in the Nordic or Irish data center markets, or increased collaboration between high-performance computing resources located in Japan and northern Europe, for example, would be useful.

It can be expected that many Japanese stakeholders will benefit from the Arctic cables once they are completed. However, to make these projects more attractive to potential Japanese partners, **it is advisable to consider how Japanese companies could benefit and be incorporated in the planning construction and installation of the Arctic cables**. Many trans-Arctic cable projects have been quick to announce that their key technology partner is Alcatel Submarine Networks. Therefore, rather than identifying the Japanese NEC as one of the trusted suppliers whose expertise could be utilized, the Arctic appears as a region automatically earmarked for its European competitor. Even if Alcatel has incomparable competencies and competitive edge related to the Arctic part of the cable system, it may be useful to consider whether Japanese companies can have a bigger role to play at the long Pacific part of the trans-Arctic cables.

The Japanese Government (the Ministry of Economy, Trade and Industry and the Ministry of Internal Affairs and Communications) has supported the decentralization of digital infrastructure by providing significant subsidies for companies building their new (AI) data centers in Hokkaido, for example. Sakura Internet received 57 billion yen (yen is currently week, but this is approximately 350-370 million euro), and 30 billion yen (180-200 million euro) has been allocated to Softbank. Apparently, the funding allocated for data center projects in the previous round has been used, but new funding is expected. Furthermore, the funding for new landing stations and submarine cable infrastructure remains to be allocated. If this funding is used to support the trans-Arctic cable initiatives and improve Hokkaido's international connectivity, the operational conditions for all actors (currently and in the future) involved in the data center industry in Hokkaido would be enhanced. As a result, the need for subsidies allocated to individual companies might decrease and both Japanese and international companies could invest in Hokkaido even without support from the central government. The regional government and local municipalities could naturally continue providing their own support schemes to attract investments (Hokkaido Government 2023). The EU may not be in a position to give direct policy recommendations to the Japanese Government on a predominantly domestic matter. However, since Hokkaido's position in the Japanese and East Asian data center market shares many similarities with the Nordic market in Europe, references to a relatively recent study showing the significant economic impact the trans-Arctic cable would have on the Nordics could guide the Japanese Government in the desired direction. In general, the northward shift within the Japanese data center market should support the cause of the trans-Arctic cables.

Among the Japanese regions, **the EU should pay a special attention to Hokkaido** because of three reasons. As the northernmost island of Japan, Hokkaido would gain the greatest competitive advantage from the trans-Arctic cable (if the cable lands in Hokkaido). Hokkaido's current problems related to the lack of international connectivity are more severe than in other Japanese areas hosting significant data centers clusters. In 2018, then Foreign Minister Taro Kono described Hokkaido as a gateway from Asia to the Arctic, and the Japanese Government has already expressed its interest in supporting the development of Hokkaido as an emerging data hub.

The US and Canada are connected to Europe and Japan through various existing cable systems. Therefore, when negotiating about the trans-Arctic cable projects with the North American partners, the EU should emphasize the potential synergies between international and domestic projects and the connectivity needs of Alaska and Canadian Arctic. While the projects are the same, **the starting point for discussion with the US and Canada differs significantly from Japan. With Japan attention is paid to improved connectivity through the Arctic, but the North American stakeholders are primarily interested in improving connectivity in the Arctic**.

An opinion piece published in a Canadian newspaper at the end of November 2024 emphasized the importance of developing international connectivity in the Canadian Arctic. While explaining the activities taken by other like-minded countries and emphasizing the inactivity of the Canadian Government, the article also argued: "Some countries are planning to install subsea cables through Canada's Arctic without our consent, recognizing opportunities in Canada's Arctic that we have yet to fully seize (Kennah 2024)." While this may very well reflect the opinion and understanding of the single author, the claim made in the opinion piece emphasized **the importance of keeping the Canadian and Alaskan stakeholders aware of the ongoing developments to achieve the so-called social license to operate**.

Besides securing the acceptance of the proposed projects among public authorities and other important stakeholders in the US and Canada, it may be advisable to reinforce the team promoting the trans-Arctic cable projects in North America. It can be expected that persuading the northern communities will be relatively easy if the planned cables land in those communities. However, negotiations with national governments may be more challenging. To ensure the necessary permissions and, if possible, economic support for marine surveys, it is important to present a clear message describing the benefits to the US and Canada. At the same time, it is crucial to confirm to like-minded partners that the planned projects do not threaten their strategic interests.

The Far Nort Fiber project, or any project planning to connect the EU and Japan through the Northwest Passage could also consider the cable system design introduced as a part of the already failed Arctic Connect project. The new cable system could include both fiber pairs connecting the EU and Japan without any connection to the Arctic regions they pass through, as well as designated fiber pairs making landings in the Arctic communities in Canada, Alaska and potentially Greenland. While this may complicate the cable design, such an approach would highlight both the European and Japanese digital strategic autonomy and sovereignty, as well as the trans-Arctic cable projects' contribution to the improvement of connectivity in the Arctic. A clear distinction between the roles of the various fiber pairs could also be considered when planning the overall funding scheme for the cable system.

The Japanese Arctic studies community's interest in the Arctic SMART cables could be increased by promoting relevant initiatives in international forums where Japan is also present (such as International Arctic Science Committee and Arctic Council) and/or emphasizing the Arctic initiatives in international forums that gather researchers interested in SMART cables. Furthermore, as the trans-Arctic cables would cross the Pacific Ocean through a new route, they could provide new environmental observation and seismic monitoring opportunities in North Pacific (in areas with relatively close to proximity to Japan).

Japan is one of the most disaster-prone countries in the world, frequently experiencing natural hazards such as earthquakes, tsunamis, volcanic eruptions, and typhoons. It is thus understandable that risk awareness among the general population and government's disaster preparedness measures are often guided toward natural hazards. While statistics show that unintentional cable damage (related to bottom-contact trawling and anchors, for example) forms the greatest danger to submarine fiber-optic cables, the EU members states have recently experienced various suspicious incidents causing major damage to their critical infrastructure. In these occasions, difficulties to identify the instigators and prove the intentionality, have become obvious. **When explaining the importance of the Arctic cables to Japanese partners from the perspective of network diversity and security of supply, the EU could refer to its recent experiences.**

When the EU introduces security and international connectivity related arguments to the Japanese Government, two important objectives need to be achieved. First, there is a need to convince the Japanese partners about the importance and validity of these arguments speaking on behalf of the trans-Arctic submarine cables. Second, there is a need to convince the Japanese Government, which traditionally leans on the US in security-related matters, that the identified risks and problems cannot be solved by improving direct and indirect (through like-minded countries in the Asia-Pacific region) submarine cable connections to the US West Coast. Here, one challenge is to justify the necessity of public support to the Arctic route at the situation where private companies are already installing cables from Japan to the US, and from the US to Europe. While explaining why a great dependency on the US is a problem, one should be careful not to dispute its role as an anchor of Japan's foreign and security policy and a like-minded partner whose support, or at least acceptance, is needed to carry out the planned projects.

If the security-related concerns are emphasized, this may open new possibilities for funding. However, the significant role played by actors representing the military or the sphere of national security may also push away some commercial actors.

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5. Appendices

APPENDIX 1: The composition of the Expert Group on the Development of Digital Infrastructures (2024)

Chairperson

Jun Murai (村井 純), Professor, Keio University

Experts

Hiroshi Esaki (江崎 浩), Professor, Graduate School of Information Science and Technology, The University of Tokyo

Motohiro Tsuchiya (土屋 大洋), Professor, Graduate School of Media and Governance, Keio University

Hideki Wakabayashi (若林 秀樹), Professor, Graduate School of Business Administration, Tokyo University of Science

Industry representatives

Masatoshi Sarashina (更科 雅俊), Executive Officer, General Manager of the Construction Business Headquarters, Daiwa House Industry Co., Ltd.

Kei Furuta (古田 敬), CEO of DIRC and Co-founder of Digital Edge Group

Kazushi Minagawa (皆川 和志), Executive Director, HOTnet

Junichi Miyagawa (宮川 潤一), President and CEO, SoftBank Corp.

Norishige Morimoto (森本 典繁), Executive Vice President, Chief Technology Officer, and R&D Officer, IBM Japan, Ltd.

Observers

Ministry of Education, Culture, Sports, Science and Technology, Advisor for Research Promotion Bureau (Information)(文部科学省研究振興局参事官（情報担当）付学術基盤整備室)

Ministry of Land, Infrastructure, Transport and Tourism, Technical Investigation Division, Minister's Secretariat (国土交通省大臣官房技術調査課)

Ministry of Land, Infrastructure, Transport and Tourism, Technical Policy Division, General Policy Bureau (国土交通省総合政策局技術政策課)

Ministry of the Environment, Global Environment Bureau, Climate Change Mitigation Division (環境省地球環境局地球温暖化対策課)

In 2023 (Report 2.0) the composition was slightly different in 2023 (Report 2.0). The Chairperson and the experts were the same, but the Industry representatives included also Ryūya Urakawa (浦川 竜哉, representing Daiwa House Industry instead of Masatoshi Sarashina), Yasuo Nakayama (中山 泰男, substituting Mr. Nakayama also Yasushi Matsumoto (松本 泰) from Secom), Chairman and CEO, Secom Co., Ltd. Furthermore, the Observes included also Senior Advisor to the Director-General of the Digital Agency (デジタル庁統括官付参事官)

APPENDIX 2: The composition of the Hokkaido Nutopia Data Center Study Group Steering Committee (2024)

Director:

Tsuyoshi Yamamoto (本 強), Emeritus Professor, Hokkaido University

Vice-Directors:

Hiroshi Esaki (江崎 浩), Professor, Graduate School of Information Science and Technology, The University of Tokyo; Director, WIDE project

Jay Kishigami (岸上 順一), Specially Appointed Professor, Muroran Institute of Technology, W3C Deputy Director

Jun Murai (村井 純), Professor, Keio University; Founder, WIDE Project

Auditor:

Shuji Nakamura (村 秀治), Director, Hokkaido National Higher Education and Research System; Advisor, Mitsubishi Research Institute

Members:

Yasufumi Kuwahara (桑原 靖文), Executive Vice President, Board Member, Arteria Networks, Inc.

Yoshihito Kurose (黒瀬 善仁), President and CEO, Kyocera Communication Systems Co., Ltd.

Juha Saunavaara: Associate Professor, Hokkaido University Arctic Research Center

Kunihiro Tanaka (田中 邦裕), President and CEO, Sakura Internet Inc.

Satoshi Baba (馬場 聡), General Manager, Hokkaido Telecommunications Network Co.,Inc (HOTnet).

Hiroshi Fujiwara (藤原 洋), Chairman and CEO, Broadband Tower, Inc.

Kei Furuta (古田 敬), President, Digital Edge Group / CEO, Digital Infrastructure Consulting LLC

Akihiro Maeda (前田 章博), CEO, Bitstar, Inc.

Eiji Murata (村田 英司), President and CEO, Oji Engineering Co., Ltd.

Naotaka Yanagawa (柳川 直隆), President, Flower Communications Co., Ltd. / Hokkaido Industrial Cluster Advisor

Secretariat:

Kumi Mitani (三谷 公美), Director, General Incorporated Association LOCAL; Cloud Business Division, Sakura Internet Inc.

Jun Yoshida (吉田 淳), President and CEO, Cloud Networks, Inc.